THE

ELECTRICAL REVIEW.

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SEASIDE LINES.

ALTHOUGH the present time of writing is hardly one that tempts the average reader to think of the seaside with an appetite (unless it be the blue Mediterranean), we have a particular and substantial reason for touching so early in the year upon the subject of electric tramways or light railways along coast routes in the neighbourhood of watering places, and this reason consists of the fact that we have waited until the time of application for new schemes under the Light Railways Act had expired in order to see what developments might be expected in this direction.

Engineers—like wholesale drapers and Christmas card makers—are obliged to be independent of the seasons usually very much ahead of them; and if a particular new line of railway or tramway is to be built and equipped for the summer traffic, then the engineers must set to work promoting the scheme in the previous summer and winter, and carrying out the work during the spring time.

It is with this in view that we now treat the subject, in order, too, that some efforts may be made to push electric lines during the next few months in the principal seaside districts.

One gets rather tired of using the United States as an object lesson in regard to electric traction developments; yet the enormous progress across the Atlantic may still serve to punctuate and emphasise our desperate slowness over here. In some respects, we are not particularly anxious to emulate American progressive methods, certainly not in the dashing reckless mode of doing things that leaves drawbridges open for trolley cars to drop through, or uses such indifferent design and workmanship on the rail returns, bonds, and feeders, that half the gas and water pipes in a district are eaten up. This is progress blindfold, and we don't want to emulate it here; but still, every one now admits electric traction to be a good thing—and, what is more, a cheap thing—even when installed according to solid and expensive English ideas.

The coast line along the whole New Jersey shore resembles, in one respect at least, the shores of North Wales or Lancashire, inasmuch as it offers health-giving resorts to crowded populations in all the towns and cities from New York to Philadelphia—both included; and over a distance of 40 miles or more from Sandy Hook southwards there is one continuous line of seaside houses and villas, with towns and villages every few miles apart.

All these are practically inter-connected by means of trolley lines, and the resulting traffic is, as may be supposed, of a very heavy and profitable nature. The district here dealt with is only one out of many such. Long Island itself (on the Atlantic side) has developed enormously since the installation of electric lines, and this in spite of existing steam railway connections, practically paralleling the electric lines.

Out of 28 applications for powers to construct light railways under the recent Act, there are four lines which seem

to partake of a similar nature to those above indicated—they run respectively from Colwyn Bay to Llandudno; from Grimsby to Saltfleetby; from Flamborough to Bridlington; and between Ramsgate, Margate and Westgate. We must presumably be pleased that there are as many as four; but at least 14, if not 40, places or centres for lines of this description could be pointed out where they would pay—and pay well.

Of course there are already a few in existence—notably the Dublin line to Dalkey, with its ultimate extension to Bray; also the Brighton-Rottingdean amphibious line, half boat, half car; the lines from Lytham to Blackpool, and extension to Fleetwood; the lines in the Isle of Man radiating north and south from Douglas, not to speak of the Portrush-Giant's Causeway, and the Guernsey lines.

But one only needs to take an ordinary map of Great Britain (and Ireland—it may as well come in also) to see the scope there is for lines intended to connect together not only seaside resorts, but also populous centres along the coast where local industries create a demand for traffic conveniences all the year round.

Taking England and Wales alone, for instance, there would seem to be ample room for a trolley line interconnecting the places along the coast of North Wales between Rhyl and Bangor; and if proof is wanted, it would be easily found in the fact that the London and North-Western Railway Company long ago made up their minds to increase their accommodation along this piece of their line, laying three or four tracks over most of the distance in order to cope with the traffic.

The whole of the west coast of Wales presents a good field for well considered schemes, such as would undoubtedly be promoted by the Cambrian Railway Company, did its finances allow of so much development. In fact, any sea coast within 150 miles of the Lancashire and Yorkshire manufacturing districts will be found to offer scope for tourist lines, so fond are the people of travelling and "trips."

Much the same remarks apply, of course, to the south coast within range of London, and anywhere between Weymouth and Margate. It is not, indeed, unlikely that the whole coast will sooner or later be fringed with a service of electric lines between the various towns that spring up so rapidly, and yet are always growing. As an instance may be mentioned the district from Brighton to Bognor, already provided with a steam railway, but quite ready to support an electric line, with its cheaper and quicker service.

We leave other localities to be found by our readers; there are plenty of them, however, quite enough to go round and give every one enough to do in electric traction for some time to come. Let us hope that the next list of applications to the Light Railway Commissioners (to appear, we suppose, in June next), will be longer and still more promising than that now published.

The New President of the Institution of Electrical Engineers.

Sir Henry Mance, C.I.E., M.I.C.E., comes from a Devonshire family. He was born at Exeter in 1840, and educated at Mr. Sturgiss' private school in Bath, which he left after becoming premier scholar of his year. He then entered the Electric and International Telegraph Company, in which service he remained until 1863, when he was appointed by the Secretary of State for India to the Government Persian Gulf Telegraph Department. Although only 24 years of age, he was rapidly promoted to the rank of superintendent, and for some years served in that capacity in Mesopotamia, Persia, Arabia, Beloochistan and India. He acted as traffic manager for one or two years, and was subsequently appointed engineer and electrician, which post he held until his retirement. His last official act in 1885 was to renew the cable which he helped to lay in 1864. The official report of the expedition, written by Sir Henry, gives much useful information. He has contributed several valuable papers to the technical journals, and is the author of the well known "Mance's Methods," the first being for ascertaining the internal resistance of a battery, the second for eliminating the effects of polarisation and earth currents when testing faults in submarine cables. Since his retirement from the Indian service, Sir Henry has associated himself with some of the more important telegraph companies. He is also chairman of the Oxford Electric Light Company. He is a Companion of the Indian Empire, and received his knighthood in 1885 in recognition of important services rendered by him to Government in connection with his invention, the heliograph. The Spaniards were the first to adopt this method of signalling; and a report of their experiments with Sir Henry Mance's apparatus will be found in the pages of this journal. He has been a member of Council of the Institution for some years, vice-president since 1893, and we feel sure, judging from the tenor of his address, that his year of office will be productive of good to the Institution.

Examination Tests for Civil Engineers.

A correspondent of the *Engineer* raises the question of the value of the title "civil engineer", considering that the Institution should in the future provide that all joining Members and Associates be put through some form of examination. Were such a test applied to the present members we fear the ranks of the Institution would be seriously depleted, but we have no doubt the gaps could be speedily filled by outsiders who cannot now find an entrance. A pupilage with a well-known civil engineer will admit at present, but this rule permits of much mediocrity and excludes many good men. At the same time we confess to having little liking for examination tests, for one is inclined to doubt whether such a test would after all improve very much upon even the present modes of admission. Would not an examination test have a great tendency to keep out the able men who can carry out practical work and yet can do very little on paper. We have met scores of able engineers whose pupilage has often been very irregular, men who have become engineers without knowing they were so doing, and yet they would be kept out by an examination. As we write these lines we are fresh from a consultation with a man who spent the first 30 years of his life in the sale of a manufactured product, simply because he was the son of the proprietor. Only when thrown penniless on the world did he achieve any actual work, and to-day in his own special line he is *facile princeps*, and is second to few in many of the details of steam and mechanical engineering which have come under his ken as supplementary to his main business. The examination test would not find this man out as a genius unless the papers were set in a manner very different from what seems to be the inevitable. The present age has been termed the age of examinations, but it by no means follows that the age is right. Practical men know that still in many branches of the arts and manufactures the success of a process is determined by the skill of the weekly workman quite as much as by the technical ability of the chemist or the engineer in charge.

A MECHANICAL THEORY OF ELECTRICITY AND CHEMICAL ACTION.

BY ARTHUR WHITWELL, M.A., A.R.C.Sc.I.

(*Continued from page* 56.)

We must now show that our electric current will set up a magnetic field. It is rather difficult to determine the direction of the change of density in the ether round an indefinitely long single wire conveying a current, the direction can more easily be determined for a solenoid. Fig. 5 shows a section of a solenoid. The molecules rotate clockwise on the left and counter-clockwise on the right-hand section. If we consider the molecules on the inside surface of the coil, it will be seen that each molecule tends to drag the ether downwards; a thin cylindrical shell of ether next to the coil will be dragged down or stretched more than a thin cylindrical shell nearer the centre of the coil. The resultant effect is then a pull in the direction of the arrows, decreasing from the circumference to the centre. In any concentric cylindrical shell the density, normal at a great distance, gradually diminishes in the direction of the arrow from A to B, after

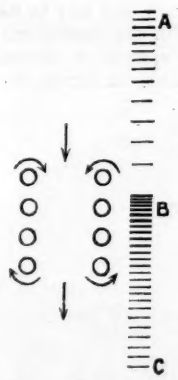


FIG. 5.

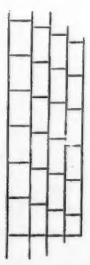


FIG. 6.

which there is a compression, and the density gradually diminishes from B to C, becoming normal at a great distance.

Fig. 6 shows a section of the ether in the coil, the increased density being shown by the lines being closer together. A conductor moved across the field to the right, either between A and B, or between B and C, would have its molecules rotated counter-clockwise.

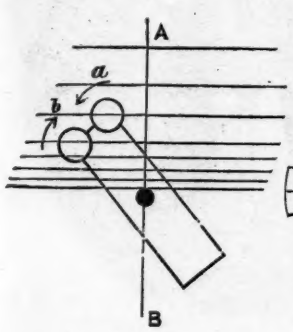


FIG. 7.

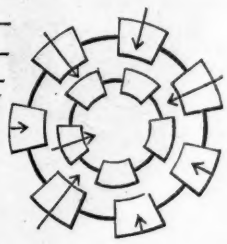


FIG. 8.

When placed in a magnetic field a solenoid free to rotate on its centre places itself along the lines of force. Fig. 7 shows a solenoid placed in a magnetic field, and free to rotate on an axis perpendicular to the plane of the paper. The only rotating molecules which will tend to move it on this axis are those in the plane of the paper, and of these one tends to move it one way, and the other the other. The forces acting are equal, so the one with the greater arm overcomes the other, and pulls the solenoid along the lines of force that is along A — B. If the rotation in section *a* be clockwise, the end, *a b*, will be pulled towards A; but if the rotation in section *b* be clockwise, that in *a* will be counter clockwise, and *a* will move to the left, its moment being greater than that of *b*, consequently the end, *a b*, will swing round till the moment of *b* is bigger than the moment of *a*, then the rotation of *b* will bring the end, *a b*, towards B.

The solenoid acts like a magnet. A magnet, then, according to our theory, must consist of a number of vortex rings of ether and rotating molecules threaded on the axis of the magnet (fig. 8). The molecule must be assumed to have a large moment of inertia, so that once started they will continue rotating for a considerable time; they must also be assumed to be more or less smooth, so that their energy of rotation is not converted into heat very quickly; they must also have a grip on the ether so as to be capable of straining the ether or of setting up a magnetic field. The molecules of hard steel have great inertia; they are hard to rotate but keep their rotation a long time; on the other hand, soft-iron molecules have less inertia and they are more easily magnetised, but lose their rotation quickly. When a bar is magnetised and the molecules are rotated, the ether is strained and a magnetic field is set up. The work done in time, *dt*, in magnetising a bar is spent in three ways.

1. Work done in increasing the energy of rotation of the molecules themselves $= \text{M}\ \omega\ \frac{dw}{dt}\ dt$ as before.

2. Work done in straining the medium $= \text{N}\ \omega\ dt\ k \int \omega\ dt$ as before.

3. Work done in distorting the bar.

As regards the third portion, it will be seen that the pull of the ether on the solenoid in fig. 5, or the pull of the solenoid on the ether is in different directions inside and outside, and that the effect of magnetisation will be to lengthen and distort the solenoid or bar. This distortion will be proportional to the displacement, that is $= l \int \omega\ dt$, and the work done will be proportional to $dv\ l \int \omega\ dt$, where dv is the change of volume.

The equation of energy is

$$\text{M}\ \omega\ \frac{d\ \omega}{dt}\ dt + \text{N}\ \omega\ dt\ k \int \omega\ dt + d\ v\ l \int \omega\ dt = \text{N}\ p\ r\ \omega\ dt.$$

The work done in distorting the bar is partly given up again when the bar is demagnetised, but a portion is converted into heat, and is called the hysteresis loss. The meaning of the other coefficients is the same as in the equation for the electrical circuit. The right-hand term involves a turning moment as before, but now we call it magnetomotive force. If a magnet be broken into pieces, it is clear that each little piece must be a little magnet. If a closed circuit or loop be moved to the right in fig. 1, no rotation results, because the turning moments on the two halves of the circuit are the same, and when the ends of the halves come together, the turning moment in one half exactly balances that in the other. Similarly, if an iron bar be moved in a uniform field as in fig. 9, the molecules will not

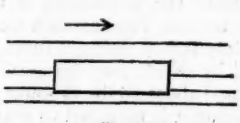
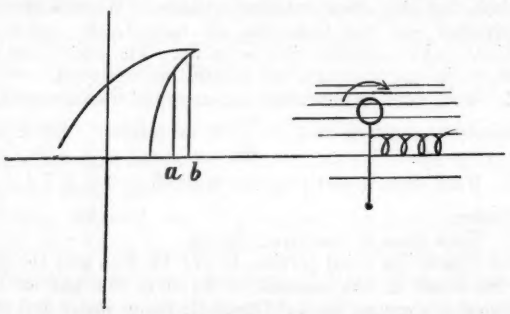


FIG. 9.

be rotated in rings on the axis, because for a similar reason the turning moment on any particular ring will be zero. To magnetise a bar it must be moved in a field in which the density varies in two directions. Moving a bar into a solenoid is doing this; consequently the bar is magnetised.

When a current starts in a circuit, the strain in the ether is fed outwards in all directions, and if there are masses of iron in the field, the varying strain fed across them will rotate certain rings of molecules, and make the pieces of iron into magnets; the energy of rotation of the molecules of the magnet is derived from the turning moment in the electric circuit, hence the M in the first term of equation (1) includes all the molecules of all the magnets created in the field, and the self-induction of a circuit is enormously increased by the presence of a magnetic substance in the

field. If an iron bar be placed in a solenoid, and the current be gradually increased, the turning moment on the rings of molecules will gradually increase the rotation of the magnet's molecules, and the strain on the medium will gradually increase. Now, suppose the current to gradually diminish, the magnetomotive force or turning moment will now be in the opposite direction, but before the magnet molecules can change their direction of rotation, their energy of rotation must be first destroyed. When the current comes down to zero, the molecules still have a certain amount of rotation; this is the residual magnetism. When the current is reversed and gradually increased, the energy of rotation of the magnet is gradually brought to zero, and then the rotation and the polarity of the magnet is reversed. Magnetic angular velocity, or magnetic intensity and current angular velocity, or strength of current, vary together, as shown by the familiar hysteresis curve. The magnetomotive force produced by the rise of the current form, *a* to *b* (fig. 10), is



Figs. 10 and 11.

the same as, but in the opposite direction to, that produced by a fall of current from *b* to *a*. Why, then, does not the curve representing magnetic intensity or molecular angular velocity return on itself? Take a single molecule (fig. 11), and suppose the ether, when the current rises, to pull the top half to the right, and so produce a clockwise rotation. The ether not only does work on the molecule by giving it rotation, but also distorts the magnet itself, or compresses the spring shown in fig. 11. When the pull of the ether diminishes, a counter-clockwise couple diminishes the angular velocity a little, and the molecule is moved to the left by the compressed spring, the effect of this last motion is to tend to rotate the molecule in a clockwise manner, and so to keep up the angular velocity; hence the angular velocity does not diminish as fast as it increased. It may be pointed out that this explanation of magnetic hysteresis also applies to hysteresis in a dielectric.

(To be continued.)

BOILER TESTS.

Some of our more ponderous contemporaries are apt to publish results of boiler and engine tests without taking the trouble to investigate the probability of their truth. The *Engineer* is taken to task for this in a recent case reported by it, where a certain forced draught furnace showed results above that secured by an ordinary draught. In one case the boiler only evaporated about 26 lbs. of water per pound of coal. With the forced draught it managed to evaporate 36 lbs.

The absurdity of the whole thing was that the trial with large Lancashire boilers, 30 feet by 7 feet 6 inches, lasted half an hour, and the results were apparently gauged by the measurement of the water level and by guessing at the condition of the fires; and this in half an hour. It is bad enough to find water consumption in vertical boilers from gauge glass measurements, but for boilers with a water surface of about 200 square feet, and large grate surfaces, the absurdity of such measurements and a half-hour test, when only 1½ cwt. of fresh coal was put on the fires, is too palpable. How came Prof. Galloway to put his name to such a report? He must have known how thoroughly inconsequential the figures were. It may have been true that the patent tested really was as much superior to ordinary draught as was claimed, and that the test was simply comparative. We don't like this word comparative. It is getting to be used as a cloak to cover tests made on plant which is specially designed to give wide divergence of results favourable to a patent. It is decidedly unfair to make a test of any plant which is not capable of giving good commercial results, without the improved appliance to be tested in comparison.

Figures may be obtained in a perfectly truthful manner, but their publication would be of no real value to anybody, for they would deceive the layman. Some engineers do not seem to mind what sort of figures they publish so long as they can say: These are what we obtained. If such figures are published, it is unfair to do so without a full explanation as to why they were obtained. Unfortunately, interested people are apt to publish extracts from the expert's reports which were never intended to be separated from their context, and possibly something of the sort has happened with Prof. Galloway.

SIEMENS'S HAND-PRESSURE ELECTRIC DRILL.

When Messrs. Yarrow & Co. were building the Argentine torpedo boat destroyers *Santa Fé*, *Entre Rios*, and others, they made use of Messrs. Siemens Bros.' interesting hand drill. The great feature about this drill is that it can be readily carried about by a workman, and may be used in any other position than that shown in the illustration by means of suitable slings. The drill spindle is driven through reducing gear by an electric motor, the current to which is

supplied through a flexible cable, so that the drill may be at a considerable distance from the source of power. The whole drill is self-contained, and is fitted with a cut-out and switch; to avoid any injurious shock on the termination of drilling, the end of the drill is fitted with an india-rubber cushion.

The drill illustrated will bore holes up to ⅜-inch in diameter, and weighs 46 lbs., the drill spindle runs at about 300 revolutions per minute; the motor takes a current of 2 amperes at a pressure of 110 volts: equal to a third of a horse-power.

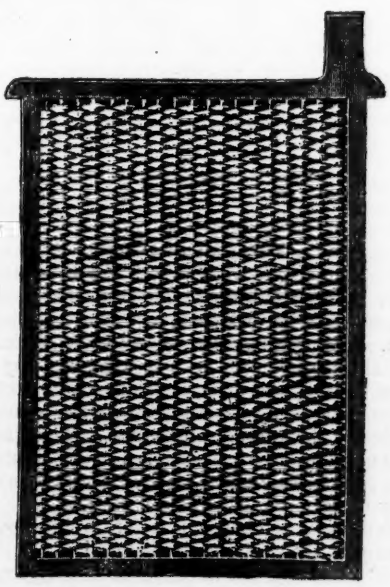
From experience it has been found that whilst eight holes per hour can be drilled by hand, 35 holes can be drilled in the same time with the electrically driven drill.

THE GÜLCHER ACCUMULATORS.

The Gülcher accumulators differ from all others in one essential feature; the supports of the active material of these accumulators consist neither of plates nor leaden grids, but of a tissue in which leaden wires form the warp, and threads of spun glass the weft. The supports formed in this manner which are shown in the accompanying figure, receive the active material which is retained in the meshes of the tissue; it is then distributed in very fine filaments, which adhere so firmly that the most violent shaking cannot detach them.

The electrodes thus constructed do not buckle, and the active material is not detached.

The plates being suspended in the vessel by means of ebonite supports and being, besides, encased in a layer of spun glass, an excellent insulation is obtained and the whole arrangement is rendered very elastic; the electrodes can never come in contact with one another, and thus any distortion or short-circuiting from a shock, or from any other mechanical cause is avoided.



The employment of elastic spun glass for insulating the plates from one another (instead of the rigid glass tubes generally employed for the purpose), does not increase in the least the internal resistance of the element as has been shown by recent experiments; moreover, this arrangement enables the plates to be placed very close together (at intervals of 3 mm.), which has the effect of somewhat lessening the internal resistance of the element.

The electrolyte has a specific density corresponding to 24° Baumé. The capacity is from 43 to 45 ampere hours per kilogramme of positive electrodes, for an output of ·46 ampere per square decimetre of positive plate.

The plates are made in three different sizes:

100 × 150 mm.
200 × 150 mm.
200 × 300 mm.

They all have a uniform thickness of 3 mm.

The Gülcher accumulator is intended specially for traction and for the lighting of vehicles of all kinds; it has the advantage of comparatively light weight in proportion to its capacity.—X. (*L'Electricien.*)

BLOCK SIGNALLING.

That one of our contemporaries should differ from us in the views expressed in our article under the above heading, which appeared in our issue of the 1st inst., was perhaps to be expected, and is, perhaps, not very material; but that which we do regard as material is the reasonableness, and what we believe to be the soundness of our observations, and this we say in the same interest as that in which our article was written—the interest of our readers.

In referring to the invention, which was in point of fact the initiative of our article, we were careful to so direct our comments that they should be applicable to the principle underlying that class of signalling to which the special reference applied; and we desire that our present comments may still be viewed in that light. We would not that our readers should imagine we had not weighed and considered the subject in the light in which our contemporary finds an opportunity to view it. Nor is it to be imagined for a moment that the point has been neglected, or left unconsidered, by the responsible officers of the various railway companies. If we could probe their views, we should find that the possibility of the railway traffic being worked under two systems of signals would never for an instant be entertained, and that their conclusions would be perfectly confirmatory of those to which we have given expression. The engine driver has too much to do, and too grave a responsibility to admit of his checking the action of any subsidiary system placed upon the engine in the manner suggested. With trains travelling at a speed of a mile a minute, with block posts, and distant and "home" signals on the busy portions of the line at distances varying from a quarter to half a mile, the driver's observations must be made at periods varying from a quarter to half a minute. Incorporate this with his other duties, and consider the consequences of an oversight! We yield to none in our desire to foster the electrical industry. We do not say it is inapplicable to the purpose indicated by us. We do not think, however, that until the time comes when the movement of trains may be effected by electrical agency, that automatic signalling will, to any extent, be employed by English railways. We do not believe that English railways will ever incur the responsibility which attaches to the employment of two methods of signals for governing the same train. Who is to determine when one is to be paramount, and the other not? Is it to be left to the driver? Who shall say, when a difference arises, who is in fault? The system would be blameable, and not the individual. Of course, a signalman may see the position of his *switch* or "lever," and it may be such as will, in ordinary course, convey to the driver of an approaching train an order to stop; but it does not follow that the signal will reach him. It may be so arranged that the signal shall be repeated back, but the fact that the repetition has told the signalman of its failure to reach the driver would be of little avail. The signalman may operate with perfect accuracy his portion of the apparatus, but so long as there are parts on the locomotive which require to be actuated in consonance with the action of that part operated by the signalman, and until it is known that those parts have faithfully responded, it is impossible to regard the signal as conveyed. Nothing is perhaps more easy than for a person possessing a certain knowledge of the properties of electricity to point out how easily all that is required may be assured, and to confirm it by model or isolated plant. But will practical working support it? Hitherto such has not been the case. Locomotive engines are not, like signal boxes, stationary objects, and if they are required to carry electrical apparatus which has to be always in order, the electrician must be at all times on the spot to attend to them. Where will he find them? Is a locomotive, the electrical gear of which has, happily in sufficient time, been found to be out of order, to be laid up or dragged home as a dummy, until the telegraph lineman has restored it to life?

We have said that a reliable substitute for the present mode of fog signalling would be hailed with welcome by the railway companies. We make no doubt of it. The expense for what is termed "fogging" is heavy; it involves loss of rest, and, possibly, loss of health, to those who are engaged in it, and it incurs, in many instances, a degree of risk to life which is undesirable, We do not believe it will be replaced by any description of automatic signals, nor by a double system of signals, but by that which will be capable of being brought into use at the will of the signalman, just as at present the services of the fog-signaller is called into operation at the will of that official. Whether this will be accomplished by mechanical or electrical power is still a

question of the future. Our sympathies are, naturally, with the latter; and to those of our friends who care to rack their brain in its accomplishment, we would say, Keep your motive power, and as much as possible of the other parts, on the ground, and not on the locomotive.

In our original remarks we thought it quite unnecessary to enter into our reasons for adopting those views to which we gave expression. We felt assured that those who had experience of railway work, and in all probability to others, our reasons would be so obvious as to need no explanation. We are, however, above all things desirous that it should be seen that our views have, to a rational mind, a rational basis, and this must be our apology, if any is needed, for again reverting to the subject.

ELECTRICAL WAVES IN LONG PARALLEL WIRES.*

By A. D. COLE.

The experimental study to be described in this paper was undertaken as a preliminary to a research on the refractive index of certain liquids for electrical undulations, as deduced from a measurement of the ratio of the wave length in the material under investigation to that in air. That research has been published in *Wiedemann's Annalen* (February, 1896), and in full abstract in the last number of the *Physical Review*, but so many facts not hitherto described were noted in the preliminary study, that I have ventured to bring them before you in the present paper.

Stationary electrical waves were produced in two long wires, according to the method of Hertz and Lecker, by means of the apparatus shown in fig. 1.

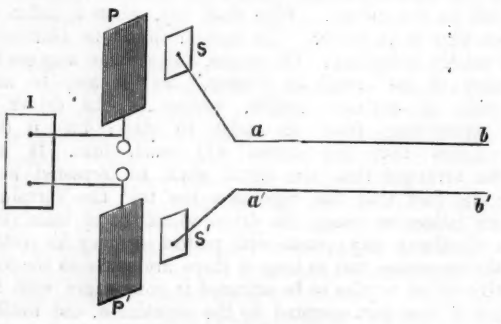


Fig. 1.

I is an induction coil capable of giving a spark several centimetres long. Wires from its secondary terminals are joined to the two primary plates, P, P', the latter being connected together (except for a spark gap of 2 to 4 mm.) by short rods terminated by brass balls.

The distance between the primary plates could be varied by sliding these rods in their support, and the resulting changes in the capacity and self-induction of the system controlled the oscillation period. The primary plates were 40 cm. square, and $\frac{3}{10}$ths cm. apart. From the oscillations set up in them by the discharges of the induction coil, oscillations were induced in two secondary plates, each 10 cm. square, placed a few centimetres in front of the primary plates. To the centre of each secondary plate a long wire was attached, and these two wires, after approaching (as seen at a, a') to a distance of 8 cm. apart, stretched away horizontal and parallel a distance of about 4 metres. At every oscillation of the secondary plates a wave of electricity passed along each wire, was reflected back at its end, and produced by interference with new advancing waves, a system of stationary waves, with alternating nodes and ventral segments, analagous to the stationary sound waves in a vibrating stretched string.

A short wire placed across the parallel wires in general caused the glow to cease; but a few positions could be found such that the tube placed across the ends of the wires still continued to glow. Three such positions could be found with the apparatus used. These were separated by equal intervals and marked nodal positions, any interval giving the half wave length of the undulations in the wires. The ends of the wires and terminal plates form ventral segments in the resonance system. H. Rubens* had succeeded in measuring not only the length, but the form and amplitude of such waves by use of the instrument devised by Paalzow, and named the "dynamo-bolometer." I used the same instrument employed by Rubens in his study of stationary waves in wires. Fig. 2 shows its construction. R_1, R_2, R_3, R_4, are the resistances of a balanced Wheatstone bridge. Two of

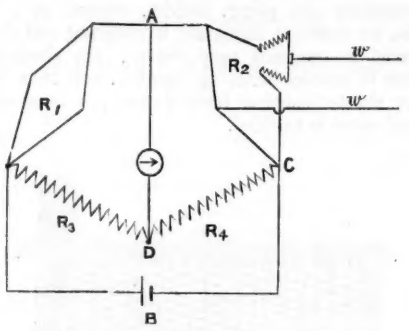


Fig. 2.

these, R_1 and R_2, are themselves balanced bridges, each of their four arms being a very fine iron wire about 10 cm. long and of 7 ohms resistance. Suppose the whole system balanced, and a weak but steady current supplied by the battery, B. The galvanometer shows no deflections. Evidently, if alternating currents such as produced by electrical oscillations enter by the wires, w, w', they will circulate only in the minor bridge, R_2, but will disturb the balance of the main bridge by the heating effect in R_2. This disturbance, if not too great, will be proportioned to the heating effect producing it, and this in turn, as the authors have shown, to the energy of the oscillations in the wires, w, w'. The galvanometer deflections become, therefore, a direct measure of the intensity of the electrical oscillations.†

To avoid disturbing the wave system in the wires, Rubens did not attach the wires, w, w', from the dynamo-bolometer directly to the points of the parallel wires to be investigated, but to little Leyden jars, made by placing around the wires bits of glass tube surrounded by shorter strips of metal foil as "outer coatings," the wires themselves forming the "inner coatings." With this apparatus, larger galvanometer deflections, obtained when the bridge wire is at a node, correspond to the glowing of the Geissler tube in Lecher's arrangement.

The wave distribution along the parallel wires was studied as follows:—The Leyden jars were placed over the ends of the wires, a bridge of wire placed in a definite position across the wires as shown by a tape measure stretched below, current sent through the induction coil, and the galvanometer deflection produced by the heating of the dynamo-bolometer read. This was repeated three or four times for each bridge position, and bridge positions taken 5 to 10 cm. apart over the whole length of the wire. Many such series of observations were made, the conditions being varied somewhat to learn the effect of such variation. The results may be best presented in the form of curves, abscissæ representing positions of the bridge on the wire and ordinates the means of four to six corresponding galvanometer deflections in millimetres.

Rubens had noted that the number of maxima in a curve is diminished by (*a*) increasing the distance between the primary plates, and (*b*) leaving a bridge at a maximum position and exploring with a second sliding bridge. These conclusions may be verified by comparing a number of my curves. Thus, in one case, there are six strong maxima and perhaps eight weaker ones. In this experiment the primary

* Abstract of paper read before A. A. A. S., Buffalo meeting, taken from the *Electrical World* of New York.

* *Wied. Ann.*, 42, p. 154 (1891).
† *Wied. Ann.*, 37, p. 769 (1890).

plates were 4·5 cm. apart. By increasing this distance to 8 cm. the three strong maxima, separated from one another by intervals of 146 cm., almost disappeared, the other three remaining.

Again, by leaving a bridge in the position corresponding to the maximum nearest the secondary plates and exploring with a second bridge, all but three of the 15 maxima practically disappeared. These three occupied positions, 8, 154·5, and 303·5 cm., at practically equal distances apart. The middle one was especially strong and sharp, the other two weaker but about equally strong. The effect of a fixed bridge is thus to reduce a somewhat complicated wave system to a simple one.

The maxima obtained were so improved in both strength and sharpness by the use of a second bridge, that two very careful determinations of their position were made to get an idea of the degree of precision allowed by this method of calculating the half wave-length.

First time, maxima at	25·3	188·5	351·4	Intervals, 163·2	162·9
Second time, maxima at	24·8	188·4	351·5	Intervals, 163·6	163·1

At any one time the nodal positions seemed to be capable of being located within a fourth of a centimetre, and on repeating the experiment the same results could be expected within a half centimetre.

Still greater steadiness and definiteness was secured in some later experiments by the use of three or even four fixed bridges.

No change has been attributed to a change of the distance between primary and secondary plates by other experiments so far as I am aware; but a comparison of several of my curves seems to indicate quite clearly that diminishing this distance increases the complexity of the curve.

As it was my plan to estimate the refractive index of a number of liquids by surrounding a portion of two parallel stretched wires, by the liquid under investigation, it seemed desirable to use the wires much nearer together than other experimenters or I myself had done before, in order to avoid the necessity of using a larger amount of liquid than I could readily obtain. I accordingly set up my apparatus again, with the wires only 3 cm. apart. By this change two distinct results were produced. In the first place, the deflections produced corresponding to the maxima positions on the wire were considerably reduced in amount, viz.: to about one-third of the value before obtained. This was easily provided for. As the galvanometer used had been adjusted to only moderate sensitiveness, a new adjustment of it gave deflections sufficiently large. The other changes noticed by bringing the wires nearer was a shortening of the interval between nodal positions. To make sure of this result and to measure the amount of the change, three complete determinations of the three maxima were made, readings being made at each centimetre on the wire near the maxima positions. The results are as follows:—

			Means.	Difference.	Previous.
26·6	26·7	26·5	26·6	...	...
187·5	187·5	187·5	187·5	160·9	163·4
347·4	347·7	347·5	347·5	160·0	163·0

The three determinations agree so well that there can be little doubt of a shortening of the internodal interval by about 3 cm., or 1·5 per cent. But the true change is more than this, for the bridges themselves form a part of the resonance system, and two-thirds of their length should be added to the apparent internodal distance to get the true half wave-length. The bridges were 12 cm. long in the first instance, and 3 in the second.

This correction gives 171·5 as the half wave-length for wires 8 cm. apart, and 162·5 for wires 3 cm. apart, a change of 9 cm., or more than 5 per cent.

It became desirable next to study the effect of surrounding a portion of the parallel wires by a containing vessel such as would be suitable for holding a liquid. A covered trough of zinc, 100 cm. by 10 × 10 inches with the wires passing centrally through the ends through rubber stoppers, was used, one end being made to coincide with the centre maximum.

The internodal spaces, which had been equal before, were now different, that which included the metal box being shortened 3·3 cm., or about 2 per cent.

(*To be continued.*)

THE VISCOSITY OF POLARISED DIELECTRICS.

THE list of changes observed in the mechanical properties of a non-conducting liquid on subjecting it to electrostatic stress, is a very short one, and that notwithstanding the fact that the subject is one of the greatest importance, because of its bearing on the question of the nature of electrification and electrostatic stress.

Quincke (*Wiedemann's Annalen*, x., p. 521, 1880) found that some liquid dielectrics expanded in volume, and others contracted under electrostatic stress; but Röntgen (*Wiedemann's Annalen*, xi., p. 890, 1880) on repeating the experiments, failed to find the contractions, and explained the expansions as due to heat produced by the passage of electricity through the dielectric; hence no satisfactory conclusion has been reached. Kerr (*Philosophical Magazine*, November, December, 1875; August, September, 1879) discovered that a liquid dielectric became double-refracting under electrostatic stress, some liquids acting "like glass extended in a direction parallel to the lines of electric force," and others "like glass compressed in a direction parallel to the lines of electric force." These phenomena of Kerr are, however, only inferentially mechanical. W. König (*Wiedemann's Annalen*, xxv., p. 618, 1885), Pagliani (*Ac. Torino*, 20, p. 615, 1815; 22, p. 1, 1887, *Winkelmann's Physik*), Noack *Wiedemann's Annalen*, xxvii., p. 289, 1886, *Winkelmann's Physik*) examined the viscosity of the dielectric, but failed to find any alteration of it due to electrostatic stress. Faraday's observation ("Experimental Researches," xii., 1350) that fibres of silk in the polarised dielectric stretched themselves in the direction of the electric force, is an illustration of the effect of different inductive capacities. Hence, it would seem that we still lack positive knowledge as to the effect of electrostatic stress on the mechanical properties (density, compressibility, viscosity, &c.) of liquid dielectrics.

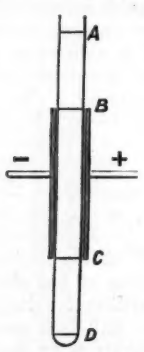
About a year ago, A. Wilmer Duff undertook to re-examine the question of a possible viscosity variation, but at first failed to find evidence (at least, conclusive evidence) of any such effect. The experiments were carried out in the physical laboratory at Dundee University. The method employed was not that of measuring the flow through a capillary tube placed between the condenser plates (König), but one depending on the rate of descent of small spheres through a viscous liquid. Failing to find the effect sought, he has lately repeated the experiments with more care, rather with a view to fixing a superior limit to a possible viscosity variation than with the hope of actually discovering such a variation. The results obtained seem, however, to point clearly to the existence of the variation in question. Not many liquids have as yet been examined, as it seemed of more importance at first to thoroughly test one liquid under varying conditions. The results are given in *Technology Quarterly*, Vol. iv., pp. 23—38, and are limited to two or three liquids; and the extension of the methods employed to other liquids, together with a study of the law of variation of the effect under varying intensity of stress, are left to a future paper.

It seemed desirable to employ some method which would eliminate the effect of temperature variations, and hence use was made of the formula (Lamb's "Motion of Fluids," 1879, p. 184), found by Stokes for the rate of descent of a sphere through a viscous fluid. The steady velocity attained by a sphere falling through a fluid is:

$$v = \frac{2}{9}\,\frac{\rho - \sigma}{\eta}\,g a^2,$$

ρ being the density of the sphere, σ that of the fluid, a the radius of the sphere, and η the viscosity of the fluid. This is on the assumption that there is no infinite slipping between the sphere and the liquid, and that none such exists (at least in the case of such materials as were used), has been shown by Mr. O. G. Jones (*Proceedings* Physical Society of London, 1894, or *Nature*, February 22nd, 1894). In the remainder of the work, the only assumption made from the above formula was that as the viscosity of a liquid increases, the time of descent of a sphere through a given distance in the medium also increases.

If, then, a tube be filled with a viscous liquid, and the time of descent of a small drop of mercury through the length of the tube be noted, and the tube be then inverted between the plates of a charged condenser, any change of viscosity would be shown by a change in the time of descent of the mercury drop. This would imply, of course, a constant temperature for the liquid; but such being unattainable, the following modification was made for approximately eliminating the temperature effect: Instead of the whole tube being placed between the condenser plates, the plates were placed opposite the middle half of the tube only, rings being etched around the tube to mark off the upper quarter, A, B, the middle half, B, C, and the lower quarter, C, D, of the length through which the descent was observed. By means of two carefully tested stop watches, the ratio of the time of descent through B, C, to the sum of the times of descent through A, B, and C, D, was obtained. This ratio would, of course, be independent of the actual size of the drop (providing its steady velocity was attained before reaching A), so that the inversion of the tube was unnecessary. Another drop was then allowed to descend, and the above ratio again obtained, the condenser being in this case charged. By this method of taking ratios, we get rid of the effect of any steady variation in temperature affecting the whole tube equally. Hence, barring local inequalities in temperature variation, if any change of the viscosity of the liquid between B and C were produced by the electrostatic stress, we should find a difference between the ratios obtained above.



After a preliminary set of seven series of observations on glycerine in a room not artificially heated, it was decided to continue the investigation in a room of more constant temperature with a liquid less sensitive to temperature, but still of suitable viscosity, using a large body of liquid whose temperature might not change so readily. Details of the arrangements adapted are given. Castor oil and heavy paraffin oil were chosen as the liquids to be tested, and the results are given in a series of tables. The readings obtained seemed to show that castor oil suffers an increase of viscosity under electrostatic stress. The author therefore cast about him for other possible explanations of the apparent increase. This part of the paper is exceedingly interesting, and shows with what a perfectly open mind the problem was attacked. As, however, the inquiry as to other causes ended negatively, we can pass it by and note the conclusion, which was as follows:—The viscosity of castor oil is increased by about one half of 1 per cent. when the oil is subjected to the electrostatic stress produced by a potential gradient of about 27,000 volts per centimetre, or 90 E.S. C.G.S. units of potential per centimetre.

It having now been shown pretty conclusively that at least one dielectric undergoes a change of viscosity under dielectric stress, it becomes an *à priori* probability that other dielectrics are similarly affected. Hence there is no longer any cause to doubt that the earlier experiments on glycerine were reliable in their indications, and that glycerine also has an increased viscosity under electrostatic stress.

The only other liquid tested by Duff's method was heavy paraffin oil (specific gravity = 888). But an examination of the tables of results shows that the evidence as to this liquid is hardly conclusive. It seems possible, however, that heavy paraffin oil suffers a decrease of viscosity, though the decrease is much less than the increase in the preceding liquids, and much more difficult to determine. It should be noted that the failure to find an increase of viscosity in paraffin oil, or, still more, the discovery of a decrease, is a strong evidence of the validity of the method employed in these experiments. The only detraction from this argument is that much smaller drops of mercury were used in the case of paraffin oil than in the case of castor oil. In all other particulars the method was the same.

The method described in this paper can only be applied to very viscous liquids. For testing less viscous liquids, Duff has constructed two separate forms of apparatus, in which capillary tubes are used in such a way as to eliminate temperature effects. These have already been applied to testing several liquids, and to examining the effect of different intensities of dielectric stress and different degrees of unsteadiness or non-uniformity of field. These results will be given in another paper, to which we shall look forward with interest.

LIGHTING OF A COUNTRY RESIDENCE.

THAT the owners of country residences have not more generally availed themselves of the advantages of electric lighting is perhaps not surprising when we consider how formidable the mechanical and electrical features of such a plant are likely to appear to them, and with what apprehension they are apt to view the result of its operation by the unskilled labour upon which they would have to depend.

In point of fact, at the present day an isolated electric light plant for a country residence can be so installed as to occupy little space, and be efficiently operated by almost any of the men kept about a place of any size, in some cases without notably interfering with their usual duties. A gardener or coachman is generally a man of sufficient intelligence to take direct charge of the plant; his presence may sometimes be necessary for a few moments at starting up or shutting down, but a boy or stable hand can attend to the plant while in operation, which need not be more than twice a week.

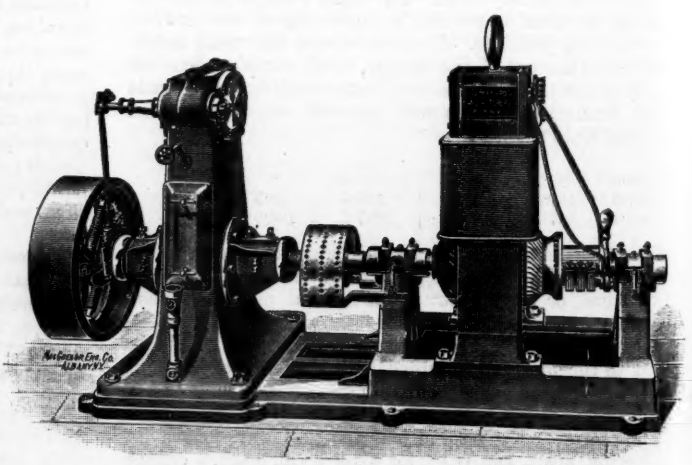


FIG. 1.

To illustrate by a specific case, writes Mr. E. G. Bernard in the *American Electrician*, the following information is given relating to a plant installed about four years ago by the E. G. Bernard Company, of Troy, N.Y., at the summer residence of Mrs. Wm. Howard Hart, near Troy. The installation, which consists of boiler, engine, dynamo, storage battery and necessary wiring, has a capacity for 100 16-C.P.,

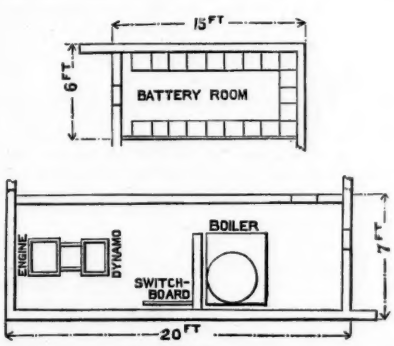
75-volt lamps, and is used for house, stable and grounds lighting.

The generating plant (fig. 3) occupies a small space in one end of the stable, the space being divided into two portions by a brick wall. One room contains the boiler and its necessary fixtures, and the other the engine, dynamo, and switchboard. The battery occupies a small detached building (fig. 2) about 50 feet distant, and in the immediate rear of the residence.

The boiler is a vertical one, rated at 15 H.P., and is covered with cement. It occupies a floor space, including ash pit and piping, of 6 ft. by 6 ft. Fig. 1 shows the engine and dynamo. This direct connected unit consisting of a Case engine and a Bernard dynamo, occupies a floor space of $2\frac{1}{2}$ by $6\frac{1}{4}$ ft. The engine, operating at 80 lbs. pressure and 550 r. p. m., has its shaft direct connected to that of the dynamo by means of a flexible coupling, which always assures smooth running. The dynamo has a wrought-iron field circuit, is shunt wound, and has a capacity of 45 amperes at 125 volts. Fig. 3 shows the arrangement of the generating plant.

The battery consists of 42 cells of 500 ampere-hours capacity, and is of the "Chloride" type. The cells are arranged in series on shelves, permitting easy accessibility. 38 of the cells, with an average of 78 to 80 volts, are placed on the main circuit. The remaining four can be thrown in or out by the reserve cell switch, thus keeping the voltage constant. These extra cells are always kept fully charged. A plan of the battery room is shown in fig. 2.

Fig. 4 shows the switchboard connections. The dynamo



Figs. 2 and 3.

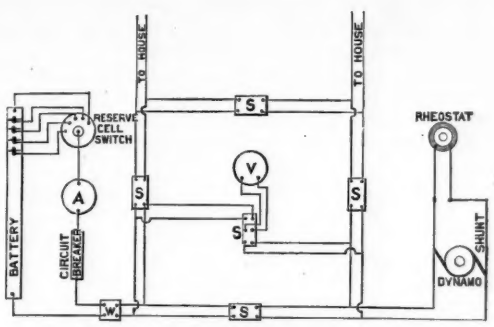
mains lead to a double-pole fused switch mounted on the switchboard, and wires lead from the switchboard to the storage battery room and to the house lighting circuits. The lamps in the house are installed on two separate circuits, and by means of switches, both of these circuits can be operated in parallel from either the storage battery or the dynamo, or one circuit may be operated independently from the dynamo, and the other from the storage battery. The two house circuits are ordinarily connected to the battery in parallel; on special occasions, such as entertainments where considerable extra light is required, the dynamo supplies one circuit and the storage battery the other. The house is wired for 100 lights, but only from 25 to 35 are ordinarily used.

The dynamo voltage is regulated by means of a rheostat mounted on the switchboard. A wattmeter is connected in circuit to indicate the amount of charge and discharge. The reserve cell switch is mounted in the battery room. An automatic circuit breaker is used on the main line to prevent the battery current from flowing back to the dynamo, and is set to break the circuit at 5 amperes or less. The battery is charged twice a week with 45 amperes of current to commence with, which is gradually reduced to about 20 amperes at the end of the charge.

All details are so simple that a 15-year old boy employed about the place has entire charge of the plant, from firing the boiler to starting the engine and dynamo, charging the batteries and throwing the switches. In fact, the following instructions cover his entire duties:—

"First. Fire boiler and get up 60 to 80 lbs. of steam. Second. Start engine and dynamo, and adjust the voltage of dynamo to about 120 volts. Third. Throw out the house switches (two) and throw in the battery switch. Fourth. Adjust the rheostat so that the ammeter indicates 45 amperes flowing through the battery; keep this up three hours, then reduce for three hours to 35 amperes then further reduce for three or four hours more to 20 to 25 amperes. This will charge the batteries sufficiently for from three to eight days, according to the time of the year, &c.

A system for residence lighting even more simple than the above, is one employing a gas or gasoline engine belted direct to a dynamo. This system can be run at a remarkably low cost; in fact, there are small plants of this system running, in which the cost is stated to be not over one cent. a day per 16-C.P. light. By



s, Switches; w, Wattmeter; A, Ammeter; v, Voltmeter.

Fig. 4.—Switchboard Connections.

using one of the latest type of gas or gasolene engines, great efficiency, simplicity and constant speed can be secured, and the lighting may be done direct from the dynamo without using a storage battery.

If, however, the first cost of a storage battery is not prohibitory, it will be found an extremely desirable addition, even with a gas engine, for while the gas engine will run without any engineer or special care, it is yet very convenient to fall back on the storage battery during the hours when only a limited amount of light is required. In addition, the storage battery will double the capacity of the plant for special occasions, as above noted.

THE BERNE TELEGRAPHIC VOCABULARY.

There appears to be little abatement of the disapproval of the 1894 vocabulary, and as the correspondent of the *Manchester Guardian* of January 7th says: "The renewed and impracticable methods employed by the Berne officials to bring it into shape and fit for general use must be considered by merchants as most unfortunate. It is more than evident that they will have none of it, and if some method cannot be devised for the joint consideration of its compilation, it would be better to consider if the question should not be shelved; at all events, no good purpose can be served by the issue of circulars, which have the object only of patching. We have a list before us which we presume must have been in official hands for some time, of words which are, without doubt, dangerous to transmit and likely to cause error. That they should not have appeared in the vocabulary is evident. This list contains no less than 661 words divided into 14 divisions according as they have more or less identical signals, actual equivalents, and have only one or more letters different, &c. Notwithstanding this, the correspondent of the *Manchester Guardian* now calls for renewed and strenuous opposition of all concerned to the circular issued by the General Post Office, London, in December, 1896, which he states to be a new illustration of the unskilful and bungling manner which the International Bureau carry out the Buda-Pesth resolution. In face of the list just mentioned, the only unsuitable words found by Berne is stated to be 28, which are to be withdrawn. They range from A to W, and as there can be very few more after W, the correspondent can

get little comfort from the information that they are to be informed if there are any more to be depleted. It is also suggested by Berne that the expressions "Howso," "How soon;" "Mylord;" "Mylady;" are improper combinations and should not be used! These grotesque combinations are declared unsuitable, and as they are not words at all the *Guardian* asks why they are not expunged and others substituted. Regulation VIII. contained in the Post Office Circular would have been by itself intelligible enough to merchants but the *Guardian* calls attention to that part of the discussion of the regulation at Buda Pesth, which provides that the words to be suggested to Berne for the new vocabulary must not contain "less than five" nor more than 10 letters! We are well aware and have already pointed out that merchants are under necessity from time to time of adding to codes. The correspondent of the *Guardian* not only confirms this opinion, but expresses amusement that a minimum limitation of five-letter words should be approved at the Conference. What objection there would be to a code of "ifs" and "ands" is not quite plain to us, especially when such resuscitations as "acordelaba," "aereacion," "erbsstroh," &c., are suggested for the official vocabulary.

The prospect of a limited and compulsory vocabulary, tending to put an end to the growth of business requirements is viewed, the correspondent says, by the merchants with the deepest dissatisfaction.

SOME AMERICAN TROLLEY CAR ACCIDENTS.

A correspondent sends to the *Engineer* some details of two accidents which lately happened to trolley cars in the United States, one being attended by serious loss of life, and the other just falling short of a still more extensive catastrophe. Both involved the old familiar drawbridge business—as the obituary poet has it:—

Pitch dark night,
Open span,
No red light,
Drowned man:

though, unfortunately, it is not only the careless motorman or bridge attendant who suffers, but the helpless passenger carried to death like a log.

It is almost useless hoping to see an end of such occurrences so long as carelessness goes unchecked and unpunished. In the first case above mentioned, there were usually no less than three safety guards at the particular drawbridge involved. Substantial gates were placed in front of the drawspan, with red lights after dark; a derailing switch, provided 200 feet or so distant, obliging the car to stop while the conductor set the switch; and, lastly, the opening span was set to automatically cut off the current from the sections of track on each side of the bridge. Yet with all these precautions available, the net result seems to have been that the last-named device was out of operation at the time, the conductor did not trouble to look for red lights when throwing over the switch, and consequently the car went smashing along through the gates and open span for about 100 feet down into the river—all the people on board the crowded car, save one, being killed.

Barely a week after this, on another drawbridge close to the above, three or four cars were waiting on the dead section of track at one side until the span could be closed. The last one had been left *with its controller full on*, the motor men getting off to "pass the time of day," and have a social chat.

Naturally, as soon as the drawspan began to close, and thus complete the circuit through the sections hitherto dead, the rear car moved forward at once with full speed into those ahead, and would have knocked them all into the still partially open span, if the front car had not had its brake hard on. As it was, many of the passengers were hurt in their efforts to escape from what threatened to be another catastrophe.

It is of no use for the *Engineer's* correspondent to say that the tramway officials seem now to be alive to the importance of providing some really satisfactory safety device; none could be invented or conceived that might be absolutely relied upon under such conditions. Human carelessness upsets the most elaborate precautions, and wherever a barrel of powder is found, there will always be a fool near at hand with a pipe in his mouth and a box of matches in his pockets.

EFFECT OF RÖNTGEN RAYS ON PARAFFIN IN RESPECT TO ELECTRIC CONDUCTANCE.

By Lord KELVIN, Dr. BEATTIE, and Dr. SMOLAN.

In the course of a series of experiments which are being at present carried out in the Physical Laboratory of the University of Glasgow, we have been led to investigate whether or not paraffin is made conductive when acted on by the Röntgen rays.

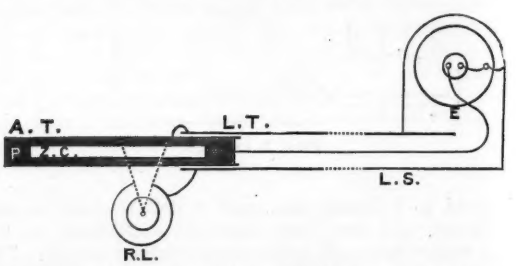
In our first experiments for this purpose we used a brass ball of about an inch diameter, connected to the insulated terminal of an electrometer by a thin copper wire soldered to the ball. The ball and the wire were both coated to the depth of about $\frac{1}{8}$th of an inch with paraffin. The ball was then laid on a block of paraffin in a lead box with an aluminium window, both of which were in metallic connection with the case of the electrometer. By this means we avoided all inductive effects, and also the disturbing influences arising from the electrified air in the neighbourhood of the Röntgen lamp.

The electrometer was so arranged as to read 140 scale divisions per volt.

After testing the insulation the paraffined ball was charged positively to 234, and the rays played on it. The electrometer reading went down gradually 81 divisions in the first half minute, 18 in the second, and after two minutes was steady at 120, or ·5 of the initial reading.

The electrometer was then discharged by metallic connection and again charged positively, this time to 259; the reading fell 65 divisions in the first half minute, 11 in the second, and after 3 minutes was steady at 161, or ·63 of the initial charge. In the third and fourth experiments the readings, after three minutes, were ·81 and ·90 of the initial charges respectively.

The ball was next charged negatively to 426. When the rays were played on it the reading fell 232 scale divisions in the first half minute, 47 in the second, 22 in the third, 17 in the fourth, and after four minutes was steady at 76, or ·18 of the initial charge. The second time the charge was 460, the fall in the first half minute was 147, in the second 25, and in the third 17; after four minutes it



A, T, Aluminium tube; L, T, Lead tube; R, L, Röntgen Lamp; L, S, Lead sheaths; E, Electrometer; P, Paraffin; Z, C, Zinc cylinder.

remained steady at 221, or ·45 of the initial charge. In the third and fourth experiments the steady readings, after four minutes, were ·70 and ·78 of the initial charges respectively.

The paraffin was then removed and the brass ball polished with emery paper; whether the charge was positive or negative, it fell in about five seconds to one definite position, 50 scale divisions on the positive side of the metallic zero, when the Röntgen rays were played on the charged ball.

These experimental results demonstrate that the Röntgen rays did not produce conductance between the brass ball and the surrounding metal sheath. From experiments by J. J. Thomson, Righi, Minchin, Benoist and Hermuzescu, Borgmann and Gerchun, and Röntgen*, we know that air is rendered temporarily conductive by Röntgen rays, and Röntgen's comparison of the effects of the rays with that of a flame shows that our experimental results are explained by the augmentation of the electrostatic capacity (quasi-condenser) of the brass ball by the outside surface of its coat of paraffin being put into conductive communication with the surrounding lead sheath and the connected metals.

In our second experiments we have endeavoured to eliminate the influence of the varying capacity of this quasi-condenser. For this purpose, we placed a strip of metal connected to the insulated terminal of the electrometer inside an aluminium cylinder; the space between the metal and the cylinder was first filled with air, afterwards with paraffin. The aluminium was connected to the case of

* J. J. Thomson, *Proceedings* R.S.L., February 13th, 1896; Righi, *Comptes Rendus*, February 17th, 1896; Benoist and Hermuzescu, *Comptes Rendus*, February 3rd, March 17th, April 27th, 1896; Borgmann and Gerchun, *Electrician*, February 14th, 1895; Röntgen Würzburger, Phys. Med. Gesellschaft, March 9th, 1895; Minchin, the *Electrician*, March 27th, 1896.

the electrometer, and inductive disturbances were avoided by surrounding the copper wire connecting the metal to the insulated terminal with a lead sheath in metallic connection with the electrometer sheath (see diagram).

In our first experiments with this apparatus we had air, instead of the main mass of paraffin, separating the insulated metal from the surrounding aluminium tube, as shown in the diagram, and we had only small discs of paraffin serving as insulating supports for the ends of the metal, and not played on by the Röntgen rays. When the metal thus supported was charged, whether positively or negatively, the Röntgen rays diselectrified it in about five seconds; not, however, to the metallic zero of the electrometer, but to an electrolytic zero depending on the nature of the insulated metal and of the metal surrounding it.

With paraffin between the aluminium cylinder and the insulated metal within, as shown in the figure, the following results were obtained:—

December 30th, 1896. 5.30 p.m.—Interior metal charged negatively. Total charge 356.

Röntgen lamp in action and no screen—

	39 scale divisions discharged in 5 mins.			
R. L. not acting	25	,,	,,	5 ,,
R. L. again acting & no screen	17	,,	,,	5 ,,

5.45.—Interior metal charged positively. Total charge 244.

R. L. in action and lead screen	1	scale division discharged in	3	mins.
R. L. in action and no screen	6	,,	,,	3 ,,
R. L. not acting	0	,,	,,	3 ,,

December 31st, 1896. 10.54 a.m.—Interior metal charged positively. Total charge 163.

R. L. not acting	2	scale divisions discharged in	3	mins.
R. L. acting and no screen ...	1	,,	,,	3 ,,
11.0—R. L. stopped	1·5	,,	,,	2 ,,
R. L. again acting, no screen	3	,,	,,	2 ,,
R. L. stopped...	2·5	,,	,,	3 ,,

11.12.—Interior metal charged negatively. Total charge 342.

R. L. not acting	10	scale divisions discharged in	3	mins.
R. L. acting, no screen ...	21	,,	,,	3 ,,
11.18—R. L. stopped ...	11·5	,,	,,	3 ,,
R. L. acting, no screen ...	16·5	,,	,,	3 ,,

These results are quite in accordance with those found in similar experiments by Röntgen; and they show that if paraffin is made conductive, it is only to so small an extent that it is scarcely perceptible by the method we have used.

THE ELECTRICAL TRADES SECTION.

A meeting of the electrical and allied trades section of the London Chamber of Commerce was held on Friday at the offices, Botolph House, Eastcheap.

Mr. Emile Garcke, who presided, briefly reviewed the work done by the section during the two years he had been chairman. Among the matters which had received the anxious attention of the section and of the chamber the foremost position was taken by the light railways legislation. They would remember that a conference was called together by the Board of Trade, at which the chamber was represented by Sir E. Carbutt and himself; and he thought they were all very much indebted to Sir Albert Rollit for his action both at that time and subsequently in Parliament. The Act was not everything they could desire, but it was a very great improvement on the former legislation. They were also greatly indebted to Major Flood Page for his action, in conjunction with the chamber, in regard to motor car legislation, on the successful issue of which he also thought they had cause to congratulate those who were interested. Among other subjects which had received their serious consideration he ought to mention the telephone question, which was dealt with by a Parliamentary committee, at which the chamber was represented by Sir E. Carbutt and Major Flood Page. Valuable services had been rendered by Mr. Sydney Morse in connection with the vexed question of rating, respecting which it was very desirable that discussion and inquiry should continue from time to time in the hope that eventually they might be able to work out some improved condition of legislation. He had desired during his term of office to do some little thing which might be of permanent benefit to the members and to the electrical industry generally, and he therefore took advantage of the facilities which his position had afforded him for producing a manual on electrical undertakings. There had occasionally been some difference between himself and some of the members as to their meetings—whether they ought not to hold more frequent or, at any rate, periodical meetings. His view was that it was not desirable to call the members together unless there were some specific business to discuss, upon which their united action was necessary. The organisation of the chamber, however, admitted of their efficiently dealing with business by calling together those members of the section who were interested in any particular question. He concluded by proposing the election of Mr. Sydney Morse as chairman of the section.

Major Flood Page seconded the motion, which was carried unanimously.

Mr. R. Percy Sellon was elected a deputy chairman, and Mr. Alexander Siemens was re-elected as the second deputy chairman.

Major Flood Page, alluding to motor-car vehicles, stated that some of them were doing all they could to prevent themselves from being identified with any of the speculative companies which had sprung up in connection with this branch of their industry, and he hoped that the section would approve of their moving extremely slowly in this matter.

PROCEEDINGS OF SOCIETIES.

Institution of Electrical Engineers.

PRESIDENTIAL ADDRESS BY SIR HENRY MANCE.

Delivered January 14th, 1897.

[Abstract.]

Although I have been closely associated with important applications of electricity to heavy engineering and electro-chemistry, I feel that the only claim that I have to the position that I now occupy is the fact that for the best part of my life I have been actively connected with submarine telegraphy. I suppose I am one of the few who can say that they have assisted at the manufacture of a cable, the laying of it, the working of it, its subsequent repair on nearly 200 occasions, and finally, more than 20 years afterwards, had entrusted to them the duty of laying a new cable in its place; that is to say, I have been closely associated with a submarine telegraph cable from its infancy to its old age.

For 40 years I have never lost touch with the telegraph, so that, after a few general remarks on other topics, I shall naturally turn to submarine telegraphy as the chief subject for my address this evening.

If this subject has to some extent dropped into the background of late years in the discussions of this Institution, it is not by reason of its want of importance, but because of the rapid and extensive development of other branches of electrical engineering.

With regard to these I do not mean to trouble you with statistics, as figures and facts in connection with

Electric Lighting and Traction

must be so fresh in the memories of those who study the weekly technical journals, that I abstain from intruding them on your notice. In the matter of traction we have been outstripped by our trans-Atlantic friends, but there is abundant evidence that this has not been caused by want of knowledge or skill on the part of our engineers or manufacturers; it is, I think, an acknowledged fact that in excellence of design and workmanship our manufacturers cannot be beaten. Our electric light stations are unsurpassed in the excellence and efficiency of their plant, electrical and mechanical, and unequalled in their suitability to the end in view. The best features of the methods preferred by us are all of home growth; and if we have to borrow from American practice in connection with the electric traction movement now upon us, we shall at least be able to point to our tunnel railways as unique, and to the Liverpool Overhead Railway as the first elevated electric railway in the world.

We have to deal in this country with local bodies which are somewhat difficult to move. This has handicapped us; moreover, our rivals have had the advantage of natural gas and water power. In America there is, no doubt, more room for expansion in every direction—here at home we have been suffering from a period of trade depression from which we have only recently emerged. We are now beginning to reap the benefits of the Electric Lighting Act of 1888, both in the number of towns seeking powers for electric lighting, and also in the extensions required for those already in existence, the magnitude of these latter promising to exceed that of the original scheme. It is to be hoped that in the future the electrical industries will not be fettered too much by officialism, and hard and fast regulations, which, formulated with the best intentions, with the view to protect the public, tend sometimes to interfere with the public convenience. It is satisfactory to note that manufacturers are turning their attention to the development of cells especially suitable for traction purposes; the advantages already claimed are, that for any fixed output the weight is reduced in the ratio of 28 to 15, and the space occupied reduced from 19 to 10. Should these expectations be fulfilled, there is every reason to anticipate an extensive use of storage batteries. There can be no doubt that from the point of view of cleanliness, freedom from smell, and steadiness in development of power, storage batteries compare favourably with steam or oil engines. Where suitable localities and proper facilities for recharging are available, it may reasonably be hoped that traction by means of storage batteries has a future before it.

Now for my next subject—

Submarine Telegraphy.

Although the ground has been well traversed on one or two occasions by my predecessors in this chair, I hope to find many points of sufficient interest to justify my bringing them to your notice.

To deal comprehensively with the history of submarine telegraphy up to recent years would be quite beyond the scope of a presidential address. To those who desire to render themselves thoroughly conversant with the subject, I recommend the perusal of a work, now in course of publication, by one of our members, Mr. Charles Bright.

The earliest record of a subaqueous line is that of the experiment made by Baron Schilling, who, in 1812, exploded mines across the River Neva, using wire insulated with India-rubber. It would seem, therefore, that Schilling deserves the credit of being the first to suggest the employment of insulated conductors under water. In 1838 Colonel Pasley, R.E., made experiments at Chatham, to demonstrate the practicability of telegraphing through lines under water. In 1839 Dr. O'Saughnessy made a series of experiments across the Hooghly. In 1840 Prof. Wheatstone demonstrated before a Committee of the House of Commons a method for establishing telegraph communication from Dover to Calais. In 1842 Prof. Morse laid down in New York Harbour an insulated wire for telegraphic purposes. In 1845 Ezra Cornell laid a 12-mile cable in the Hudson River; this cable worked well for several months, until it was broken by ice.

The earliest record at Somerset House of any submarine telegraph company is dated June 16th, 1846, when Jacob Brett and Alexander Prince obtained a renewal of their provisional certificate of regis-

tration for the General Submarine and Oceanic Telegraph Company. The first concession connected with international submarine telegraphy was also granted to Jacob Brett in 1847, that is to say, 50 years ago, so that this year we may fairly be said to be celebrating the Jubilee of the Inception of *International* Telegraphy.

The adoption of insulated conductors for *underground* wires, both in Prussia and England, may have contributed to the development of submarine telegraphy. The value of gutta-percha as an insulator began to be recognised about 1847; and we find that in 1849 an English company obtained a charter from the French Government, granting to them the exclusive right of sending telegraphic intelligence between England and the French coasts. The concession was conditional on communication being established by September, 1850; and, with the object of preventing its loss, a single wire, invested with a thick coating of gutta-percha, and sunk by means of leaden weights, was successfully laid, and messages transmitted from coast to coast. I have in my hand a piece of the identical core which was recovered some years afterwards. I may say that, as a simple core, it is quite as good as any made at the present day. Of course, such a slender wire could not be expected to stand the chafing to which it would be subjected against the rocky bottom; but the immediate cause of failure was its being grappled by some French fishermen, who promptly secured a considerable length of it, in ignorance of the real nature of their find.

In December, 1850, T. W. Brett obtained a new concession from the French Government; the outcome of this concession was that a cable between England and France was laid during the following year. The establishment of the old Submarine Telegraph Company practically dates from this time. The iron wire-sheathed cable used on this occasion is said to have been suggested by Kuper. The cable was laid by Crampton. In the present day our copper is purer, our sheathing wires of a better quality, and we have learned to adapt different types of cables to different depths; but we must admit that the 1851 type has served as a model for subsequent shallow water cables.

We who are accustomed to hear of the laying of a fresh Atlantic cable with hardly a passing comment may be apt to underrate the skill and perseverance which brought about the laying of the first Channel cable; it may, therefore, be opportune to mention, in justice to the successful pioneers of submarine telegraphy, that the three subsequent attempts to connect Ireland and England all ended in failure.

Considerable correspondence has of late appeared in the public press regarding the inception and development of submarine telegraphy. I have devoted some time to the investigation of the records at Somerset House and the Patent Office, which are sometimes amusing, and generally instructive. I have come to the conclusion that to no one individual can fairly be granted the credit of the inception and development of the submarine cable. The work has been the work of many; men of science, men with engineering skill, and men of capital, have all contributed to laying the foundation of and building up the network of telegraphs which is slowly but surely being extended to all parts of the world.

It is not for this Institution to deal with the rival claims of financier and engineer; but if we, as engineers, desire to do honour to any one individual who pre-eminently distinguished himself in the development of oceanic telegraphy, we have simply to refer to the list of our past presidents, and select the name of Charles Tilson Bright.

The earlier history of submarine telegraphy is marked by frequent failures. 20,000 miles of cable were laid during the first 16 years, but over 9,000 knots of this quantity had been abandoned before 1865. The costly experience thus purchased was derived from the failures of a series of weak and light cables, in many of which the insulation was probably defective or insufficient from the first. Some of these cables were lost during the operation of laying.

The story of the first Atlantic cable has been told by many. The experiment was a costly one, but worth the money, for it demonstrated the feasibility of safely submerging great lengths of cable in depths of over two miles. Although a commercial failure, it was a great engineering success, and during its brief existence gave a practical and striking illustration of its value. The War Department was able to countermand the movements of certain regiments, and thus avoid an expenditure of some £50,000.

Some of you may remember the Indian Mutiny, and how keenly the want of telegraphic communication with India was felt. A subsidy of £30,000 per annum was granted to the Red Sea Telegraph Company, whose cables, laid in 1859, proved a deplorable failure, notwithstanding the fact that previous to their submersion upwards of 80 different cables had been laid in various parts of the world. The sections were laid too tight, the iron sheathing was insufficient, the depth and nature of the bottom had not been properly considered, and the supervision during the manufacture was probably not of that searching character which we now find to be necessary to ensure success.

The record of the Malta-Tripoli-Bengasi-Alexandria cable laid in 1861 forms an agreeable contrast to the dismal failure of the Red Sea line. This cable was, I believe, the first sent to its destination in tanks, and systematically tested from the time of its manufacture up to its submersion. The costly failures previous to 1863 gave little encouragement to the British public to favour enterprises having for their object the extension of telegraphic communication to the East. At the same time, it was felt that communication with India was an imperative necessity, and Colonel Patrick Stewart, R.E., was deputed by Government to arrange for the construction of a landline through Mesopotamia, and the carrying out of the cable portion of the line *vid* the Persian Gulf. A good deal of the original cable laid in 1864 is still in existence. The expedition was completely successful, and communication with India was soon after established by alternative landlines through Turkey and Persia.

It was in connection with this cable that my associations with submarine telegraphy commenced. Five sailing vessels were employed to convey the cable to the Persian Gulf, and as many as 12 vessels assisted during the work, which would now be easily and rapidly executed by one well-equipped telegraph steamer. Communication between the cable ship and towing steamer was constantly maintained during the operation of laying the cable by means of semaphore or signalling lamps. Six years afterwards the cables of the Eastern Telegraph Company were laid down between Suez and Bombay, and in 1871 China and Australia were brought into communication with Great Britain.

The life of a submarine telegraph engineer is somewhat of a Bohemian character; half a landsman, half a sailor, sometimes working almost continuously day and night for weeks together, at other times enjoying long periods of enforced idleness. The localities chosen for cable stations are frequently isolated and uninteresting, the climate indifferent and the life monotonous. A more desolate place than Mussendom, near the entrance of the Persian Gulf, it would be difficult to imagine: a small island in a land-locked bay, surrounded by mountainous rocks over 3,000 feet in height; not a vestige of green to relieve the wearied eye. The Persian Gulf and its vicinity is, however, rich in historic associations.

Three hundred years before the birth of Christ, Nearchus, after conveying a portion of the army of Alexander the Great from the mouth of the Indus, disembarked at Bunder Abbas, near the entrance of the Gulf. The main body of the army, conducted by Alexander, made its way westward behind the range of hills which skirts the coast of Beloochistan. It is said that from time to time Alexander indicated his position to Nearchus by means of polished steel mirrors and reflected sunlight. This is the first recorded instance of visual telegraphy, and it is a singular coincidence that the experiments which mainly led to the introduction of sun signalling in the British and other armies should have been made upon the very same ground more than 2,000 years afterwards.

Submarine Telegraphy in 1897.

There are to-day more than 1,500 submarine cables in existence, the aggregate length of which cannot be less than 162,000 nautical miles; they vary in length from a quarter of a mile to, say, 2,600 nautical miles, and may be roughly classified as follows:—

Cables under	5	miles	in length	...	...	...	761
Exceeding	5	„	and under	50	...	...	223
„	50	„	„	100	...	...	65
„	100	„	„	500	...	...	150
„	500	„	„	1,000	...	...	64
„	1,000	„	„	2,000	...	...	29
„	2,000	„	„	—	...	...	8
							1,300

Of these cables about 18,000 knots belong to the various Governments, while the balance of 144,000 knots, mostly composed of long sections, have been laid by private companies. They represent a total expenditure of about 40 millions sterling, of which probably 75 per cent. has been contributed by English capital.

Up to quite recently nearly every telegraph cable of importance has been manufactured in this country; but England can no longer boast of a monopoly in this business. The development of French submarine telegraph enterprises is no doubt the direct outcome of the liberality with which the French Government has in recent years subsidised submarine communications. There are now established well-equipped cable works at Calais, and a smaller establishment at St. Tropez, on the shores of the Mediterranean. In addition to these, there are the Government works at La Seyne, near Toulon. The Italians have cable works at Spezzia. Germany has recently subsidised a direct cable from Emden to Vigo. Our telegraph supremacy may be considered by some as ranking next in importance to the supremacy of our Navy. This natural rivalry is not without its significance, and shows that foreign Governments are fully alive to the importance of fostering submarine telegraphy.

The sounding apparatus of Lord Kelvin has added immensely to the possibilities of ocean telegraphy. A sounding which in the old days would have taken two or three hours, and the value of which, even then, would have been doubtful, can now be ascertained in 20 minutes, and be considered reliable. Notwithstanding the heavy weights employed, hemp lines could not be relied upon. In the Gulf Stream it was found almost impossible to get bottom with them. The use of ordinary pianoforte wire has proved a complete success. With a breaking chain of 270 lbs., it offers an extremely small resistance to the water, and gives accurate results in the strongest currents. Some 2,000 fathoms could be wound in less than half an hour, even when the ship is steaming slowly ahead.

A knowledge of the contour and nature of the bottom of the ocean is of the utmost value to the cable engineer. He does his best to protect the sheathing of a cable from corrosion; but, so far as my experience goes, 2 inches of good substantial mud is the best preservative for a submarine cable. I have on many occasions recovered cable which had evidently been resting in grey mud for nearly 20 years, and I found it in as good condition as the day it left the factory. Deep sea cables have this advantage; they rest on a fairly level and uniform bottom, an advantage not enjoyed by shallow water lines.

For all practical purposes, the telegraphic engineer may regard the oozy bottom of the sea in mid-ocean as in a state of eternal rest; the deeper the water the better the bottom, the safer the cable. In shallow water, however, the bottom being subject to the action of current tides and waves, is frequently irregular, we cannot ensure that the cable will rest fairly on the ground throughout its whole length. It is certain that there will be undulations and depressions

even though the bottom may be formed of hard mud; the cable rests on the ridges of these undulations, and is suspended in a series of long or short spans. In the course of years the cable becomes encrusted at intervals with shell fish and marine life. It sways gently with every turn of the tide. Marine monsters, such as sawfish, consider it their larder, and while raking off the marine life, either rupture the cable or penetrate the core with one of their formidable teeth. In any case, sooner or later, the sheathing corrodes, and the cable parts altogether; or, as the outer wires give way one by one, the cable elongates, the core stretches until the copper conductor breaks, the ends being frequently kept insulated by the dielectric until the cable is lifted for repairs. Some of the faults that occur in submarine cables are of the most extraordinary character. Lightning, earthquake, landslips, submarine volcanoes, have all to be reckoned with; and the leviathan of the deep has more than once been responsible for an interruption. This sounds incredible, but it is nevertheless true. But probably the most dangerous pest of all is the teredo. To ward off the attacks of the latter, the plan is resorted to of covering the core with a thin taping of brass. Submarine cliffs, where the soundings rapidly vary from, say, 50 to 500 fathoms, should be especially avoided, as if the cable is not taken well inside or outside of the line of soundings indicated on the chart, but rest near the edge of the cliff, long spans will be inevitable. The deep channels at the mouths of rivers have to be negotiated very carefully, or the cable may be fractured by submarine landslips.

One of the most curious faults I have met with was that caused by the cable rolling down a submarine slope. In one direction, for a considerable distance, the iron guards straightened themselves out, while in the other direction the length of the lay had been reduced one half, and the cable had twisted itself into the most fantastic shapes.

(To be continued.)

CORRESPONDENCE.

Telephone Trunk Lines.

M. Gavey, en réponse à ma lettre publiée dans votre No. 994 du 11 Décembre dernier, dit que je parais avoir perdu de vue un point trés important. Quel est-il, ce point?

Je suis parfaitement d'accord avec M. Gavey quand il dit que dans le système Van Rysselberghe le seul objectif à réaliser consiste à aplanir la courbe du courant et à ne permettre à ce dernier qu'un développement graduel, de manière que l'émission fasse fléchir lentement et sans bruit le diaphragme du téléphone. J'ajouterai que les organes de ce système agissent de la sorte non seulement pour ce qui concerne le circuit sur lequel ils se trouvent établis, mais encore les émissions télégraphiques effectuées dans un fil armé de ces organes ne produisent aucun bruit, ni par induction, ni par conduction, dans les circuits téléphoniques voisins. J'ajouterai également, sans crainte d'être contredit, que ce résultat est obtenu, en majeure partie, grâce à la self-induction devéloppée par les électro-aimants graduateurs du système en question.

Il est aussi entendu que le condensateur shunté utilisé en télégraphie a pour rôle de neutraliser la self-induction du circuit sur lequel il se trouve intercalé, et c'est bien dans cette intention qu' un pareil condensateur a été mis en essai au bureau télégraphique central de Bruxelles, où il est introduit dans une ligne utilisée en même temps à la télégraphie et à la téléphonie et établie côte à côte avec plusieurs autres circuits télégrapho-téléphoniques.

Si nous examinons le schéma qui accompagnait ma précédente lettre, que voyons-nous? Un poste télégraphique comprenant à la fois des appareils propres àdévelopper de la self-induction (les graduateurs) et d'autres appareils dont le rôle consiste à détruire les effets de la self-induction (le condensateur shunté). Logiquement, la résultante de ces deux actions opposées, à valeurs égales, devrait être nulle et le circuit relié au poste dessiné devrait se comporter comme s'il étrait absolument dépourvu de self-induction. Or, je l'ai dit plus haut, le silence téléphonique n'a été réalisé par Van Rysselberghe qu' en donnant au circuit un surcroît de self-inductance, par l'introduction d'électro-aimants. La self-induction vient-elle à être annulée, le système devrait devenir inopérant et les signaux télégraphiques devraient être entendus dans le téléphone. Cela étant, l'introduction d'un condensateur shunté dans un circuit télégrapho-téléphonique devrait rendre aussitot les signaux du télégrape audibles dans le téléphone empruntant le même fil, et aussi dans ceux établis sur les fils voisins. Il n'en est pas ainsi cependant; les téléphones demeurent silencieux aprés comme avant l'interposition du condensateur shunté.

Je résume en posant la question à nouveau :—

Le téléphone n'est pas actionné par les signaux télégraphiques émis à travers les électro-graduateurs de Van Rysselberghe grâce à la self-induction engendrée dans ces organes; il n'est pas davantage actionné par les signaux télégraphiques émis dans les mêmes conditions quand un condensateur shunté neutralise la self-induction des électro-graduateurs. Pourquoi?

J. Pierart.

Mechanical Theory of Electricity and Chemical Action.

I do not wish to prematurely criticise the electro-magnetic theory that Mr. Whitwell is now propounding in your columns; but the fundamental difficulty to which I draw attention below must have occurred to many besides myself, and might deservedly receive Mr. Whitwell's notice in his subsequent articles.

In the opening paragraphs on p. 34, though we are spared the invention of a new ether, we are introduced to something quite new in the way of a magnetic field—to a "uniform" field chiefly characterised by the fact that it varies from point to point! "A uniform magnetic field would be one in which the density changes uniformly"—a diagram showing the increasing density by the increasing closeness of lines drawn normal to the lines of force.

I have always thought that two similarly situated centimetre cubes, taken from any two parts of a *uniform* magnetic field were as like as two peas, or as two centimetre cubes of distilled water. Mr. Whitwell says: "No! It is true that no experimental tests that you can make will show any difference between cube A and cube B, but there *is* a difference. The *density of the ether* in A is greater than in B." Heaven forbid that I should claim an intimate acquaintance with the habits of every or any ether, but I confess this appears to me incredible. Consider the case of a uniformly wound ring producing within it a uniform field. What is the ether-density at a given point, and if we take an excursion round the ring and come back to that point, what is ether-density then? Has it increased uniformly on the journey, and if so, can two ether-densities exist at one point?

It looks very much as if "ether-density" is our old friend potential in a new guise, for in potential only can two points differ in a uniform magnetic field. It is significant, too, that on Mr. Whitwell's theory an equi-potential surface must be a surface of equal ether-density. But then that mathematical quantity, potential, cannot assume such a tangible form as to run up against molecules and set them spinning!

Having reached this *impasse*, I look to Mr. Whitwell for a way out.

H. C. Haycraft.

January 10th, 1897.

Speed Regulation of Direct Current Motors.

In your article of 8th inst. on "Speed Regulation of Direct Current Motors," you refer to the paper by Mr. Ward Leonard read before the American Institute of Electrical Engineers on November 18th, 1896. After describing the method he proposes, you suggest that the paper is of theoretical interest and requires practical confirmation. I may say that in a large electrical haulage plant (130 H.P.) at the Trafalgar Collieries in the Forest of Dean, constructed by Messrs. Easton, Anderson & Goolden, Limited, in 1893, this method of regulation was adopted. It was originally suggested to me by Mr. A. Le Neve Foster who acted as consulting engineer to the Trafalgar Colliery Co., and I admit I had exactly the misgivings expressed by the writer of your article as to the results. But practical experience, using carbon brushes on the dynamo, shows it to be perfect in action. With generator and motor armatures in series, the motor may be run at only a few revolutions per minute up to its maximum speed, with most perfect control. For such a purpose no other means of regulation that I know of can compare with it.

Llewelyn B. Atkinson.

The "Blot" Accumulator.

I attended, by invitation, the meeting or "demonstration" held on Tuesday in the Prince's Room at the Hotel Cecil. The object of the meeting was evidently financial rather than scientific or instructive in a technical sense. Far more instruction, indeed, would have been obtained by glancing through the issues of the REVIEW for February 14th, 1896, and the two following weeks, than by listening to the statement of Mr. H. T. Cheswright. The hall was fairly crowded; but, outside of those specially interested in the battery exhibited, there were very few indeed, I imagine, capable of forming a valid judgment as to its suitability for traction purposes. And, of course, it was understood that the traction question was the *raison d'être* of the meeting.

I was quite willing to concede to the intelligent demonstrator, of French nationality, with whom I chatted in his own language, his figures in relation to rate of discharge or ratio of amperes to weight, viz., about 1·7 amp. per lb. as a mean and 4 amps. as a maximum—*qui chaufferait un peu trop les conducteurs*. On this, the strongest ground of the "Blot" battery, hardly any other than the "Tudor" amongst the known accumulators can be compared with it. In regard to a still more important point, the ratio $\frac{\text{ampere-hours}}{\text{kilo of plates}}$ is, I was told, no less than 12. "Ah, if Monsieur wants the value for total weight of accumulator, including everything, he must divide by 1·5, which gives 8." Yes, and if we take pounds Avoird., instead of kilos, we must again divide by 2·2, which gives over 3·6 ampere-hours.

"But," it may be asked, "are these values true, can these figures be accepted as correct? And, if so, what can you want more?"

In regard to the former question, I quite believe that the figures are correct in their application to a thoroughly "formed" "Blot" accumulator. Moreover, I have no reason to doubt that they have been verified in practice, both on the Madeline-St. Denis and the Opera-St. Denis tramlines. One reason for my faith is, that I have some recollection of certain experiments made in the year 1883, and, previously, with the De Meritens and the Kabath accumulators. Some of the results of these experiments were tabulated in the *Révue Industrielle* for September, 1883; and they are of special interest at the present moment, since there is a great analogy between the ancient accumulators I have just mentioned and the new accumulator of M. G. R. Blot. According to the authority quoted, the maximum capacity per kilo of plates in the Kabath accumulator is 64,000 coulombs = 18 ampere-hours. This would give 12 ampere-hours per kilo, and 5 ampere-hours per lb. of gross weight. These are splendid results, and I doubt not their accuracy. But, alas! where are they now—these batteries of De Meritens and Kabath, with their *lamelles de plomb?* If you would know the reason of their ultimate failure, refer to René Tamine (*Récherches théoriques et pratiques sur les Accumulateurs Electriques*, p. 84).

And, in regard to the latter question, I would say that—more especially in the case of an accumulator for traction—we *do* want more than high rate of discharge and high capacity for charge. We want, also capacity to resist continuous rough usage, shock, and vibration, and greater durablility than can fairly be expected from a delicate *lamelle de plomb*.

D. G. FitzGerald.

The Telegraph and the Berne Convention.

I should like to say just a word more in reply to the letter by the "Writer of the Article" on the above subject, which appeared last week.

I fully agree with him that it would be a very good thing if all telegraphic administrations did see their way to arriving at a mutual understanding with regard to the several signs employed, as he says, with such varied significations in different services. But of this I am certain; that they themselves, for obvious reasons, will be the first, and most willing, to establish a uniform consistency in the meanings of similar signals.

In respect of his very plausible objections to the employment of S for the horizontal bar of division, on the grounds that the expression might be mistaken for a *mixed group* instead of a *bar*, I fear I must plead guilty to an omission of a fact on my part in my last letter, the enunciation of which, I trust, may render my former statement somewhat clearer. It is this; that if S is used for this purpose, the receiving clerk, when repeating the figures back to the emanating station, according to the practice incumbent, as your correspondent must be aware, in all services, is bound to repeat the bar of division by the word "over," instead of S,* thus conclusively preventing any possible confusion of the meaning.

As to his reasons for preferring G to K for "request to transmit," I must say I consider them rather slight. And further, it is, I should say, decidedly a matter for opinion as to whether the one is an "easier" signal than the other on the Morse or mirror instruments.

I think the "Writer of the Article" misconstrued my last paragraph. I never intended to imply that the members of the Berne Conference are absolutely infallible, simply because they are thoroughly acquainted with their business, nor that it was "out of the power of your Journal .... to make any useful suggestion as to the Convention rules and regulations." In fine, I, personally, regard telegraphy as but an infant still, and consequently ever capable of improvement and correction, like other infants, when opportunity occurs, until it has attained to a pitch of perfection at present quite inconceivable. Who knows? I don't.

T. A. Hill.

Hackney Vestry Electric Lighting.

As there appears to be some misconception concerning my appointment as consulting engineer to the Hackney Vestry, and as you have recently published statements (which are not quite correct) concerning my recent correspondence with the Vestry, I shall be glad if you will kindly allow me to draw your attention to the resolution of the Vestry, whereby my scheme was adopted, and I was appointed as consulting engineer to the Vestry. The resolution to which I refer is as follows:—

"Your committee beg to report that, in accordance with reference from the Vestry, dated June 12th, 1895, they have inspected the electric light works at Dover, Bedford, Portsmouth, Cambridge and Oldham, and the refuse destructors in operation at Cambridge, Leeds, Oldham, Warrington and Southampton. The result of these visits has been to enable your committee to pronounce in favour of the practicability of the combined scheme of electric lighting and refuse destructor proposed by Mr. F. Hastings Medhurst.

"Your committee is of opinion that Mr. Medhurst's estimates of the cost of burning and collecting the refuse are safe. A careful comparison of his estimate of the working expenses of the electric lighting portion of the scheme, and the expenses which have actually been incurred in other London and provincial electric lighting works, shows that he has made liberal allowance, whilst his estimate of revenue appears to be founded on published returns of similar undertakings.

"Your committee beg to recommend the Vestry to adopt Mr. Medhurst's scheme, and to refer the matter back to this committee with instructions to engage Mr. Medhurst to prepare the necessary plans and specifications, and also for the committee to invite tenders for the immediate carrying out of the combined scheme.

"The capital account does not include any provision for the erection of stables, or the purchase of horses and vans, &c. Your committee recommend an addition to the capital account of £10,000 for these pusposes.

"All which is respectfully submitted."

The above resolution was carried by 38 votes against five on January 28th, 1896. Since then I have been constantly employed by the committee, and the resolution in question has not been rescinded.

F. Hastings Medhurst.

Electric Supply Companies Wiring Regulations.

Will you kindly inform me whether the London supply companies have power to insist that no double-pole main fuse may be placed in a building, besides that already fixed by the supply company. The Westminster Corporation prefer this being always supplied, but the Chelsea Company

* *e.g.*, 3 S 4, repeated, 3 *over* 4.

forbid it in their "Rules," and in two cases under my care flatly decline to connect the house (which otherwise passes their rules) unless these main fuses are removed.

My contention is that if these consumers' main fuses are carefully adjusted, they may prevent the company's fuses being blown out, but the Chelsea Company write that they have had so much trouble from being sent for to repair such fuses, that they consider it damages their reputation and causes inconvenience.

I cannot myself see that any supply company has power to insist upon this rule, and if you could be so good as to insert this letter in your paper, the matter will be brought before other engineers, and their opinions will be of use in deciding what is the right thing to do.

I should add that the fuses in question are fixed on the main distributing switchboard.

Safety Fuse.

[It is difficult to say off hand what are the powers of supply companies, but no doubt some of our readers may be able to clear up the matter.—EDS. ELEC. REV.]

Communication between Coast and Lightships.

I have read with interest your article on "Communication between Coast and Lightships" in the ELECTRICAL REVIEW of December 25th, 1896. I should like to mention, however, that the telephonic communication between the *Shipwash* lightship (situate about seven miles S.S.E. of Aldeburgh, Suffolk) and the shore has been very good in comparison with that of others. Ever since the communication has been completed (I think about three years ago) there have been only two interruptions, the cause being that the cable parted where it entered the lightship. The weather, or state of the sea, has made no appreciable difference in the communication.

This I consider a marked success, and ought, I think, to encourage the Post Office and Trinity House authorities to persevere in what, I think, would be one of the greatest boons to the world afloat.

Walter Riggs.

OBITUARY.

MR. JACOB BRETT.

IT is with extreme regret that we have to announce the death of Mr. Jacob Brett, which took place last Saturday evening. He had by some 19 years outspanned the scriptural age of man, and though he had for many years lived in comparative seclusion, his death will be marked with the keenest feeling of regret. To many men still happily with us, Jacob Brett was more than a distinguished pioneer in submarine cable work; he was endeared to many by a sweetness of disposition, and a charming, modest personality. He was rarely spoken of without the kindliest feelings, and no man has gone from us whose demise has aroused more profound sorrow than that of Mr. Brett. From a position of comparative affluence, he had become a poor man; but, in the words of Washington Irving, his poverty was "honestly come by and decently maintained."

Mr. Jacob Brett was born in the parish of St. James, Bristol, in the year 1808. It is impossible to speak of his work without associating with it the name of his brother, John Watkins Brett. With a fraternal affection, as remarkable as it is rare, the brothers lived together for many years; indeed, it was only the death of the elder brother that dissolved their most harmonious partnership. The names of the brothers Brett deserve recognition at the hands of their countrymen for their invention and introduction of submarine telegraphy. They did more than develop a means of communication that was destined to bring the nations together; they used their own fortunes freely to establish the system on a commercial footing, and laid in September, 1850, at their own cost, the first submarine cable between England and France. Jacob Brett took out his first patent in connection with telegraphy in 1845, and in June of the same year he registered a company named the "General Oceanic Telegraph Company." This company sought to establish communication by electric telegraph between the British Isles and continental countries, as well as between England and Nova Scotia; the latter scheme was held in abeyance for some time, but afterwards developed into the Atlantic Telegraph Company. This period was one of great activity for the two brothers, for in this same year Mr. Jacob Brett appears to have laid a scheme before the then First Lord of the Admiralty, Sir George Cockburn, which had for its object the connecting of Government offices in London with the most distant parts of the United Kingdom and with the colonies. The proposals were renewed to Sir Robert Peel, and it is interesting to remember that this was the first scheme ever suggested which embraced a system of land and submarine telegraphy; indeed, the pioneer telegraph company of the world, the Electric Telegraph Company, was not incorporated until the following year. These early schemes of the Bretts, however, failed to obtain pecuniary support in this country, and in 1847 they applied to the French Government under His Majesty Louis Philippe for permission to lay a submarine cable across the Channel from Calais to Dover. After much correspondence they obtained, at the end of 1847, a concession to lay a cable at their own expense and without exclusive rights; permission was likewise obtained from the Lords of the Treasury and Admiralty to land the cable in this country. After further delay, the Bretts obtained a decree from the Emperor of the French granting a concession for an exclusive right to lay cables from England to the French coast for 10 years. The keenest criticism was launched against the scheme in this country. Mr. Wollaston, who was associated with the Bretts in laying the cable, relates that even Brunel, the last man in the world to condemn any new proposal, prognosticated failure. It is due to Brunel to say that he was afterwards enthusiastic in the cause of submarine cables. It was on August 28th, 1850, that the Messrs. Brett laid the first submarine line connecting England with Cape Grisnez, in France, and transmitted through it type printed messages. It is interesting to mention that the cable itself was merely a plain copper wire with an insulating covering of gutta-percha; needless to say it was almost immediately destroyed, not by the teredo, but by French fishermen. In the following year the Messrs. Brett formed a submarine telegraph company, under the chairmanship of the late Sir James Carmichael, and laid a permanent four-wire cable of the iron sheathed type. This company was prosperous from the outset, and it is believed that portions of their original cable remained in working order for 30 years. In 1854 the Brothers Brett laid a cable across the Mediterranean, from Algiers to Corsica; two years later the first Atlantic telegraph company was formed, and the first cable successfully laid in 1858 by Sir Charles Bright, though it failed electrically after its submergence. The elder Brett was greatly responsible for the formation of this company, and subscribed £25,000, which was ultimately lost. He died in 1865, shortly before the ultimate realisation of the commercial working of the Atlantic cable. It is a little curious how the names of the Bretts came to be overlooked when honours were showered upon the originators of the Atlantic cable; it is left to the promoters of the Jubilee Memorial to repair the omission. J. W. Brett left the bulk of his fortune to Jacob, who for a time lived in affluent circumstances in Paris, from whence he fled at the outbreak of the revolution. He settled down in London, but his own unselfishness, legal suits, and perhaps lack of business qualifications, deprived him of his ample fortune, and at the time of his death he was dependent on a Civil Service Pension of £100, given to him in 1886 by Mr. Gladstone.

BUSINESS NOTICES, &c.

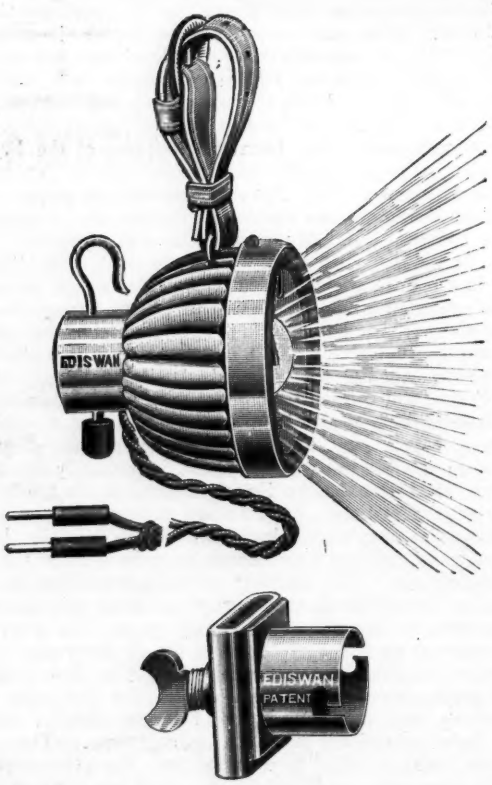
Annual Entertainment.—The annual Christmas entertainment given by the directors of the Edison & Swan United Electric Light Company, Limited, to their employés, was held on Friday night, January 8th. There was difficulty in securing a suitable hall, and eventually the Queen's Hall and Winter Gardens at the Peoples' Palace, Mile End Road, E., was hired for the occasion. A special train from Ponder's End brought about 1,000 people. A varied programme, consisting of songs, glassophone solos, animated photos, &c., were greatly appreciated. During the evening exhibitions of the Röntgen X rays were given. The entertainment concluded with a dance.

Annual Dinners.—On Friday last, the employés of Messrs. Rosling & Appleby, Trafalgar Works, Bradford, held their fifth annual dinner, when about 100 sat down. After the dinner a smoking concert was held.

A large muster of employés and friends of Messrs. Harrison, Coles and Co., electricians, of Richmond, sat down to a dinner at the Station Hotel on 1st inst.

Calendar.—Calendars are scarce this year; but Messrs. Nalder Bros. & Thompson are helping to supply the want with a neat one of convenient size, with a separate page for each month of 1897.

"Cat-Eye" Lamp.—The Edison & Swan United Electric Light Company is introducing the new "Cat-eye" lamp shown in the illustrations, for reading, examining and lighting purposes. It consists of an incandescent lamp, set in patent fittings, with nickel-plated reflector, giving a reflected light of 5 C.P., with patent sliding switch arrangement for turning the light on and off. The lamp is provided with a strap and buckle, and also with a hook attachment; it can be either suspended from a button-hole or attached to a bar, or rail, or bracket, or ledge of any kind. The lamp has a powerful lense, and gives amply sufficient light for reading or examining purposes. The illustration shows the lamp with strap at



top for fastening to any convenient place, with hook for attaching to button-hole, and with the flexible wires for making connections with the battery. It also shows an attachment for cycles, into which the lamp will fit. It is connected to an "Ediswan patent battery," so constructed as to prevent any possibility of the liquid spilling or leaking. The outside measurement of the battery in its leather case is 6 inches high, 4½ inches wide, and 2 inches deep. A list before us gives the directions for recharging the battery.

Change of Address.—The Electricity Supply Company for Spain, Limited, notify that their registered offices have been moved to College Hill Chambers, College Hill, London, E.C., and that the directors have appointed Mr. Charles Hill, secretary to the company.

Dissolution of Partnership.—The partnership that has existed between Messrs. Sharp and Mr. J. M. V. Money Kent has been dissolved by mutual consent. Mr. Money Kent will carry on an independent business, but Messrs. Sharp & Piper have secured his services as engineer-in-chief of the Holloway Electric Lighting Station. The business will be continued in future at 34, Victoria Street, S.W., and at Holloway, under the style of Sharp & Piper.

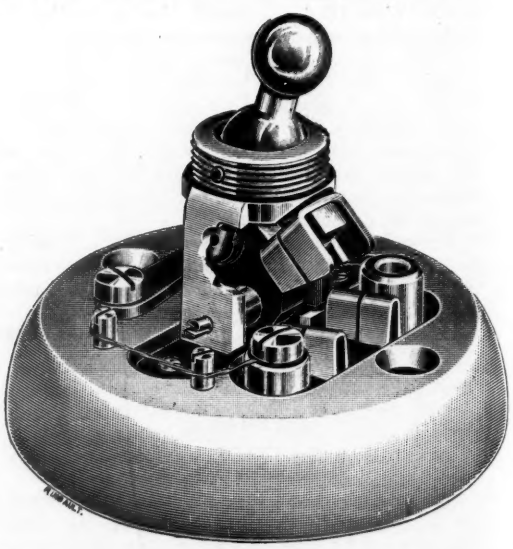
D.P. Battery Company.—We have received from this company a list of places where their cells have been adopted during the past 12 months, which includes the Oswestry Electric Light and Power Company's station, the Willesden Electric Light and Power Company's works; also the Walsall Electric Company, Limited, H.M. dockyards, and a number of country houses. The total number of plates delivered amounted to over 62,000.

Gas.—The other morning the Penzance Public Buildings were considerably damaged by a gas explosion. No one was injured.

Last Saturday a gas explosion, causing injuries to three persons, occurred at St. Joseph's Home, Longsight.

E.P.S. Batteries.—A new catalogue has been issued by the Electrical Power Storage Company, Limited, the prices in which have been advanced 5 per cent., according to the intention already notified in our columns. An advance copy of the catalogue is before us, and in addition to the details and illustrations of accumulators contained in previous lists, we observe several new types, *i.e.*, the Faure-King lighting type cells in glass or lead-lined wood boxes, and the Faure-King central station cells in lead boxes. In reference to the latter, we notice that the company now lists a cell which has a capacity of over 5,200 ampere-hours at a discharge of 730 amperes, and that the size of this cell is 4 feet 8 inches × 1 foot 6 inches × about 16 inches high. The company's largest cells in glass boxes have now a capacity of nearly 1,400 ampere-hours when discharged in nine hours. Customers can now exchange to the Faure-King type, which will enable them (by using the same number of plates which will in all cases go into the boxes of the older type) to approximately double the capacity and double the discharge rate of the cells without altering the space occupied by the battery, and this, it will be readily understood, is often of considerable advantage in existing installations. The book is bound in stiff brown covers with gilt lettering, and there is a convenient thumb index for the various sections.

I. B. Tumbler Switch.—Messrs. Verity have sent us a sample of their new design (the I. B.) of switch, in which they claim to get a longer break, and from this feature is derived the name of the switch, "I. B.," or Increased Break. A metal rocker piece is substituted for the fibre tongue, which has so long been used in switches of the tumbler pattern. A special method has been adopted for insulating the rocker from the handle and bridge of the switch. Messrs. Verity make both sizes (the 5 and 10 ampere) with and with-



out fuses, and also as a two-way switch. Block terminals are provided, which type is said to be considerably more in request than any other form. The construction of this switch makes it specially applicable for use on circuits of higher voltage. We are informed that the 5 ampere size has been tested some thousands of times on and off on a 220-volt system, and found to be little, if any, the worse at the end for the severe strain to which it had been subjected.

Liquidation Notice.—At meetings of the Electrophone, Limited, on December 4th and 21st, 1896, held at 34 and 35, Gerrard Street, Shaftesbury Avenue, London, it was resolved that it is desirable to reconstruct the company, and that the company be wound up voluntarily, Mr. John Thompson, of 56, Narford Road, Upper Clapton, N., being appointed liquidator.

"Luna" Arc Lamps.—The Electrical Company, Limited, has just brought out a small pamphlet describing and illustrating the "Luna" self-focussing arc lamps, with instructions as to installation and regulation of same. Lamps for direct current (shunt and differential self-focussing), and for alternating current (differential self-focussing), are the sections into which the list is divided.

Mica.—We are asked to state that Messrs. Wiggins and Sons, mica merchants, have, after rebuilding, returned to their old address, 102 and 103, Minories, E.C., the whole of which premises are entirely devoted to their own business.

Personal.—A New York railway contemporary says that Mr. H. E. Seemuller, of London, who is associated with Mr. Robert W. Blackwell, of Victoria Street, returned to England last month after a visit of five or six weeks in the States. While in America Mr. Seemuller made a tour of the principal cities east of the Mississippi River to become acquainted with the latest practice of American electric railway engineers. He reports that European tramway and railway managers are taking the greatest interest in electric railway equipment, and anticipates during the next year an extensive development in electric railways abroad. In this he thinks that Great Britain will lead during the coming year, but anticipates nearly as many changes in Continental roads.

Sale.—In our notice of the sale to be conducted by Messrs. Percy Huddleston & Co., by order of the receiver and manager of Bennett & Druce, on Thursday, January 21st, we used the words "in liquidation." We should have said "in Chancery."

Theft.—For stealing the property of his former employers, the Electric Construction Company, Thomas Ebrey has been sentenced at Wolverhampton to three months' hard labour.

The Central School of Arts and Crafts.—This week work has recommenced at the new Central School of Arts and Crafts, which was opened in October last at 316, Regent Street, opposite the Polytechnic. The school has been established by the Technical Education Board of the London County Council, and is under the direction of the two art advisers of the Board, Mr. George Frampton, A.R.A., and Mr. W. R. Lethaby. The object of the school is to provide for artizans, who are engaged in trades where artistic handicraft is required, a training both in the principles of artistic design and in the application of design to their specific industries.

Works for Sale.—From our "Official Notices," particulars will be obtained of some engineering and repairing works at Euston Road, N.W., together with plant, machinery, and goodwill, of Messrs. Leete, Edwards, and Norman, Limited, now carrying on business there, which are being offered for sale.

ELECTRIC LIGHTING NOTES.

Aberdeen. — The Watch Committee last week had under consideration the question of the electric lighting of the quays, especially in view of the representation from the Harbour Board, that, if gas lamps are dispensed with, the Town Council should make a contribution towards the cost of the lighting of the quays by electricity. It was agreed before deciding as to what contribution should be made, to obtain a report from the electrical engineer and lighting inspector as to what electric lighting would cost the town. To supply gas costs at present £93 2s. 9d.

Battersea.—The Vestry have determined to purchase a site for an electric lighting station at a cost of £13,900.

Bath.—At noon, on 7th inst., the electric lighting plant and works became the property of the city, the Clerk to the Urban Sanitary Authority giving a cheque for the purchase money at that hour.

Belgium.—Three firms submitted tenders for the contract for the installation of electric lighting in the Hotel des Ponts et Chaussées, in Brussels:—Messrs. Bouckaert & Co., Brussels, 8,795 francs; the Société d'Electricité "Phæton," Brussels, 9,485 francs; and the Société Industrielle d'Electricité, of St. Gilles, 9,741 francs.

Cardiff.—A Local Government Board inquiry was held last week regarding the application of the Council for power to borrow £2,000 for the provision of a public library, and £1,600 for electric lighting extensions in Cowbridge Road and Cathedral Road.

Colombo.—The Municipal Council of Colombo proposes lighting the Fort with electric light, and accordingly tenders for a contract for 25 years are invited.

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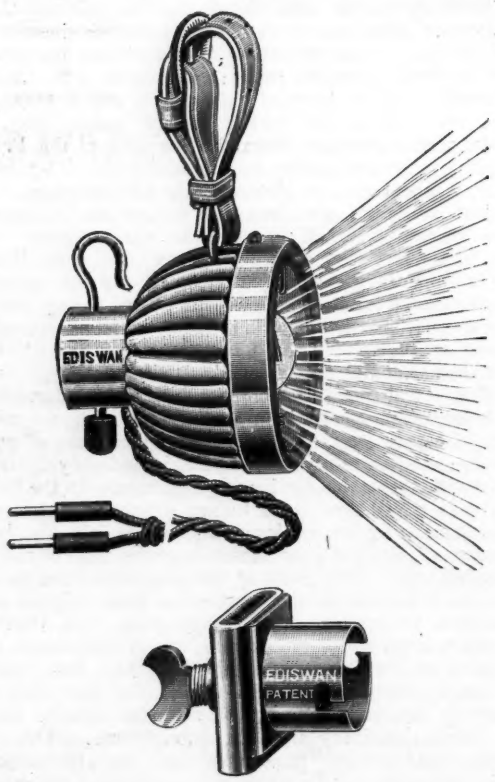
Annual Dinners.—On Friday last, the employés of Messrs. Rosling & Appleby, Trafalgar Works, Bradford, held their fifth annual dinner, when about 100 sat down. After the dinner a smoking concert was held.

A large muster of employés and friends of Messrs. Harrison, Coles and Co., electricians, of Richmond, sat down to a dinner at the Station Hotel on 1st inst.

Calendar.—Calendars are scarce this year; but Messrs. Nalder Bros. & Thompson are helping to supply the want with a neat one of convenient size, with a separate page for each month of 1897.

"Cat-Eye" Lamp.—The Edison & Swan United Electric Light Company is introducing the new "Cat-eye" lamp shown in the illustrations, for reading, examining and lighting purposes. It consists of an incandescent lamp, set in patent fittings, with nickel-plated reflector, giving a reflected light of 5 C.P., with patent sliding switch arrangement for turning the light on and off. The lamp is provided with a strap and buckle, and also with a hook attachment; it can be either suspended from a button-hole or attached to a bar, or rail, or bracket, or ledge of any kind. The lamp has a powerful lense, and gives amply sufficient light for reading or examining purposes. The illustration shows the lamp with strap at



top for fastening to any convenient place, with hook for attaching to button-hole, and with the flexible wires for making connections with the battery. It also shows an attachment for cycles, into which the lamp will fit. It is connected to an "Ediswan patent battery," so constructed as to prevent any possibility of the liquid spilling or leaking. The outside measurement of the battery in its leather case is 6 inches high, 4½ inches wide, and 2 inches deep. A list before us gives the directions for recharging the battery.

Change of Address.—The Electricity Supply Company for Spain, Limited, notify that their registered offices have been moved to College Hill Chambers, College Hill, London, E.C., and that the directors have appointed Mr. Charles Hill, secretary to the company.

Dissolution of Partnership.—The partnership that has existed between Messrs. Sharp and Mr. J. M. V. Money Kent has been dissolved by mutual consent. Mr. Money Kent will carry on an independent business, but Messrs. Sharp & Piper have secured his services as engineer-in-chief of the Holloway Electric Lighting Station. The business will be continued in future at 34, Victoria Street, S.W., and at Holloway, under the style of Sharp & Piper.

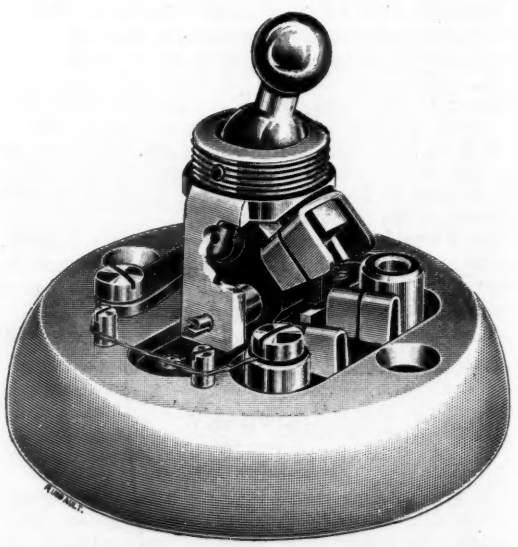
D.P. Battery Company.—We have received from this company a list of places where their cells have been adopted during the past 12 months, which includes the Oswestry Electric Light and Power Company's station, the Willesden Electric Light and Power Company's works; also the Walsall Electric Company, Limited, H.M. dockyards, and a number of country houses. The total number of plates delivered amounted to over 62,000.

Gas.—The other morning the Penzance Public Buildings were considerably damaged by a gas explosion. No one was injured.

Last Saturday a gas explosion, causing injuries to three persons, occurred at St. Joseph's Home, Longsight.

E.P.S. Batteries.—A new catalogue has been issued by the Electrical Power Storage Company, Limited, the prices in which have been advanced 5 per cent., according to the intention already notified in our columns. An advance copy of the catalogue is before us, and in addition to the details and illustrations of accumulators contained in previous lists, we observe several new types, *i.e.*, the Faure-King lighting type cells in glass or lead-lined wood boxes, and the Faure-King central station cells in lead boxes. In reference to the latter, we notice that the company now lists a cell which has a capacity of over 5,200 ampere-hours at a discharge of 730 amperes, and that the size of this cell is 4 feet 8 inches × 1 foot 6 inches × about 16 inches high. The company's largest cells in glass boxes have now a capacity of nearly 1,400 ampere-hours when discharged in nine hours. Customers can now exchange to the Faure-King type, which will enable them (by using the same number of plates which will in all cases go into the boxes of the older type) to approximately double the capacity and double the discharge rate of the cells without altering the space occupied by the battery, and this, it will be readily understood, is often of considerable advantage in existing installations. The book is bound in stiff brown covers with gilt lettering, and there is a convenient thumb index for the various sections.

I. B. Tumbler Switch.—Messrs. Verity have sent us a sample of their new design (the I. B.) of switch, in which they claim to get a longer break, and from this feature is derived the name of the switch, "I. B.," or Increased Break. A metal rocker piece is substituted for the fibre tongue, which has so long been used in switches of the tumbler pattern. A special method has been adopted for insulating the rocker from the handle and bridge of the switch. Messrs. Verity make both sizes (the 5 and 10 ampere) with and with-



out fuses, and also as a two-way switch. Block terminals are provided, which type is said to be considerably more in request than any other form. The construction of this switch makes it specially applicable for use on circuits of higher voltage. We are informed that the 5 ampere size has been tested some thousands of times on and off on a 220-volt system, and found to be little, if any, the worse at the end for the severe strain to which it had been subjected.

Liquidation Notice.—At meetings of the Electrophone, Limited, on December 4th and 21st, 1896, held at 34 and 35, Gerrard Street, Shaftesbury Avenue, London, it was resolved that it is desirable to reconstruct the company, and that the company be wound up voluntarily, Mr. John Thompson, of 56, Narford Road, Upper Clapton, N., being appointed liquidator.

"Luna" Arc Lamps.—The Electrical Company, Limited, has just brought out a small pamphlet describing and illustrating the "Luna" self-focussing arc lamps, with instructions as to installation and regulation of same. Lamps for direct current (shunt and differential self-focussing), and for alternating current (differential self-focussing), are the sections into which the list is divided.

Mica.—We are asked to state that Messrs. Wiggins and Sons, mica merchants, have, after rebuilding, returned to their old address, 102 and 103, Minories, E.C., the whole of which premises are entirely devoted to their own business.

Personal.—A New York railway contemporary says that Mr. H. E. Seemuller, of London, who is associated with Mr. Robert W. Blackwell, of Victoria Street, returned to England last month after a visit of five or six weeks in the States. While in America Mr. Seemuller made a tour of the principal cities east of the Mississippi River to become acquainted with the latest practice of American electric railway engineers. He reports that European tramway and railway managers are taking the greatest interest in electric railway equipment, and anticipates during the next year an extensive development in electric railways abroad. In this he thinks that Great Britain will lead during the coming year, but anticipates nearly as many changes in Continental roads.

Sale.—In our notice of the sale to be conducted by Messrs. Percy Huddleston & Co., by order of the receiver and manager of Bennett & Druce, on Thursday, January 21st, we used the words "in liquidation." We should have said "in Chancery."

Theft.—For stealing the property of his former employers, the Electric Construction Company, Thomas Ebrey has been sentenced at Wolverhampton to three months' hard labour.

The Central School of Arts and Crafts.—This week work has recommenced at the new Central School of Arts and Crafts, which was opened in October last at 316, Regent Street, opposite the Polytechnic. The school has been established by the Technical Education Board of the London County Council, and is under the direction of the two art advisers of the Board, Mr. George Frampton, A.R.A., and Mr. W. R. Lethaby. The object of the school is to provide for artizans, who are engaged in trades where artistic handicraft is required, a training both in the principles of artistic design and in the application of design to their specific industries.

Works for Sale.—From our "Official Notices," particulars will be obtained of some engineering and repairing works at Euston Road, N.W., together with plant, machinery, and goodwill, of Messrs. Leete, Edwards, and Norman, Limited, now carrying on business there, which are being offered for sale.

ELECTRIC LIGHTING NOTES.

Aberdeen. — The Watch Committee last week had under consideration the question of the electric lighting of the quays, especially in view of the representation from the Harbour Board, that, if gas lamps are dispensed with, the Town Council should make a contribution towards the cost of the lighting of the quays by electricity. It was agreed before deciding as to what contribution should be made, to obtain a report from the electrical engineer and lighting inspector as to what electric lighting would cost the town. To supply gas costs at present £93 2s. 9d.

Battersea.—The Vestry have determined to purchase a site for an electric lighting station at a cost of £13,900.

Bath.—At noon, on 7th inst., the electric lighting plant and works became the property of the city, the Clerk to the Urban Sanitary Authority giving a cheque for the purchase money at that hour.

Belgium.—Three firms submitted tenders for the contract for the installation of electric lighting in the Hotel des Ponts et Chaussées, in Brussels:—Messrs. Boucksert & Co., Brussels, 8,795 francs; the Société d'Electricité "Phæton," Brussels, 9,485 francs; and the Société Industrielle d'Electricité, of St. Gilles, 9,741 francs.

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Kirkby-in-Ashford.—Mr. Furse, of Nottingham, has been appointed to prepare estimates of the probable cost of a suitable electric light scheme for the District Council.

Llanelly.—The Electric Light Committee has inspected the electric lighting of New Dock Road at Mr. J. C. Howell's invitation.

Leatherhead.—We understand that the Local Authority are opposing the application of a company for electric lighting powers, and intend applying for a provisional order to do the work themselves.

Madrid.—The English Electric Lighting Company has got to work satisfactorily with the only turbine (Parsons) said to be directly coupled with an alternator in Spain.

Mile End.—The Electric Lighting Committee is asking to be allowed to spend 25 guineas in making inquiries *re* electric lighting.

Morecambe.—Several landowners have objected to the proposed site for electric light works, on the ground that such works would prove a nuisance generally.

Port Elizabeth.—A correspondent wrote on the 21st ult.: "The Harbour Board have decided to greatly increase the electric lighting of the port. An increased plant, estimated to cost £14,750, has been ordered, sufficient to light all the jetties, depositing ground, wash-houses, offices and stores, and to work six overhead cranes."

Portsmouth.—There was a failure in the supply of current on Monday, last week. The cause is stated by a local paper to be the use of unsuitable fuel in the stokers, which deadened the fires and caused a diminution of the steam pressure, so that one of the engines had to be stopped. The fuel had been received at the works the same afternoon.

Prescot.—The question of lighting the new infirmaries and the workhouse premises by electricity has been deferred for the present.

Radcliffe.—A lengthy report as to the proposed electric lighting of Radcliffe has been presented by the surveyor to the Electric Lighting Committee, and the committee has been empowered to visit such towns lighted by electricity as they might consider advisable.

Reading.—It is proposed to light the new Art Gallery by electricity. The borough engineer and surveyor is to obtain tenders.

Salford.—On a question by Mr. Jackson as to the terms of supplying electricity to the Lancashire and Yorkshire Railway Company, it was stated that the Electric Light Sub-Committee had decided the price charged for the supply of electric current for lighting purposes should be reduced from 6d. to 4d. per unit, and the price of the current for motive power from 3d. to 2d. per unit.

Salisbury.—The Board of Trade threatens to revoke the Electric Light Company's order if steps are not taken without further delay. The company has informed the Town Council that nearly all the necessary capital for payments under Messrs. Edmundson's contract (£11,000) had been arranged for, but £1,000 more of 5 per cent. debentures were offered, and perhaps Councillors might feel disposed to take some of these. The Council does not wish the order revoked for six months yet.

Southampton.—The Electric Lighting Committee recommend the Council to accept certain tenders for laying cables, earthenware conduits, and drawing-in boxes. They also recommend the increase of salaries of officers in this department, three engineers to have an increase of 10s. per week, and others smaller sums.

Southwark.—The Vestry has been recommended, says *Daily Tenders*, by the General Purposes Committee, to light the church clock by electricity at an annual cost of £62 10s., and to accept the tender of Messrs. Benson, at £25, for supplying and fixing the necessary fittings, with an additional cost of £5 for an automatic switch.

Stirling.—The report of Prof. Kennedy, who was consulted by the Police Commissioners as to the introduction of the electric light into the burgh, shows generally that the aggregate cost of lighting the compulsory area—Port Street, King Street, and Murray Place—would be about £15,000, but recommends that plant should also be put down for lighting the residential part of the town, which would bring the total cost from £20,000 to £22,000. The report recommends the continuous current three-wire system with 200-volt lamps.

Stockport.—The Gas Committee is to have a special meeting to consider the electric lighting question. The chairman has looked up the matter as regards other towns.

Taunton.—From several sources we hear that a very serious occurrence, which might have ended very disastrously, has happened here recently. "Rumours have been current in Taunton during the last few days as to a narrow escape from a most disastrous accident at the electric light works last week. The officials have naturally been very reticent about the matter; but it has been admitted that there is substantial foundation for the rumours. It appears that one of the employés neglected to replenish one of the boilers with water, but continued to supply more fuel. The result," says a local paper, "was the boiler became red hot, and had not the neglect been discovered, there can be no doubt that a terrific explosion would have happened, and the whole of the works, and possibly some of the adjoining houses, might have been shattered. The construction of the boiler was fortunately designed to guard as much as possible against any neglect resulting in such a catastrophe. Fortunately an alternative boiler was available, and was successfully utilised. The utmost consternation, of course, prevailed upon the discovery of the neglect, and the employé, who had been at the works for some years, was immediately discharged."

Wakefield.—The West Parade Wesleyan Chapel is to be lighted by electricity, and tenders are to be considered for the work.

Walsall.—The Town Council will not adopt the penny-in-the-slot system.

Waterloo.—The Liverpool District Lighting Company has informed the Waterloo-with-Seaforth District Council that it will shortly be in a position to supply electricity in Waterloo, and offering to give an estimate of the cost of supplying any of the Council's buildings. A sub-committee will meet the company's representative with the view of inviting a tender.

Wells.—It is proposed to advertise for tenders for carrying out the electric lighting scheme detailed in Dr. Hopkinson's report to the Council.

Westralia.—The London company which is interested in a scheme for the electrical power distribution for the goldfields, and which failed to get a Bill through Parliament giving it certain privileges, has decided to start operations, and proceed with the scheme formulated 15 months ago. Since then, says *Westralia*, the scheme has been remodelled, as instead of a central station being erected at Northam or Newcastle, a number of plants will be installed on the goldfields, and probably plants will be erected at Coolgardie and Kalgurli.

Winchester.—Judging by a discussion that took place at the Town Council meeting last week, it would appear that the Electric Light Committee is not as attentive to its duties as might be desired. Several vacancies on the Committee were filled.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Altrincham.—The District Council has resolved to oppose the application of the Manchester Carriage and Tramways Company for a provisional order to establish a tramway, on the ground that the line would seriously interfere with the usual traffic on account of the width of the streets, and also that the overhead system of electricity, and the use of steam power for traction, would be objectionable.

Barcelona.—Mr. Merry del Val's project for laying down and working electric tramways has been approved, and is subject to 41 conditions laid down by the Commission of Public Works, formed to consider the question. The maximum speed is to be 12 kilometres per hour, rising to 15 when empty. During the early hours of the night, and at crossings, the speed is to be reduced to walking pace.

Belfast.—The whole Council met in committee on 7th inst., to consider a communication from the Tramways Company re-proposing their offer regarding the establishment of electric traction, which the Council had already dealt with. It was resolved: "To again inform the company that the Council cannot entertain the proposal of the company for an extended term, but will be prepared to accept the offer made by the company for the remainder of the term, and to allow electric traction and the doubling of certain lines without further payment."

Blackburn.—A long and exciting debate took place at the Town Council meeting on 7th inst., on a proposal, to which we have several times referred, that the Corporation should lay down generating plant and supply electricity to the local tramway company on the overhead wire system. Alderman Eastwood, ex-Mayor, strongly contended that it was not the duty of the Corporation to assist private companies, but, on the other hand, to municipalise tramways, as had been done in other towns. The scheme, however, was confirmed, the terms agreed on being 2½d. per unit, of which sum one penny represents the expenditure on plant.

Blackpool and Fleetwood Electric Tramways.—The construction of the new line between Blackpool and Fleetwood has been commenced.

Brighton—Rottingdean.—Mr. Magnus Volk has submitted to the Brighton Council plans of the waiting rooms proposed to be constructed by the Seashore Electric Tramroad Company on the beach, east of the Paston Place Groyne, to replace those washed away by the great gale. The Committee had resolved to inform Mr. Volk that upon the company entering into an agreement, in a form to be approved by the Town Clerk, for protecting the rights and interests of the Corporation in the site of the proposed waiting rooms, the plans will be approved by the Council. To this communication Mr. Volk has replied that he had not yet had time to prepare plans for the new station, but as soon as the Council had determined upon the works for protecting the Madeira Road, he was ready to conform to the surveyor's requirements. Meanwhile, he was merely making temporary arrangements for carrying on the traffic.

Burslem.—The General Purposes Committee has received from the British Electric Traction Company, Limited, notice that they propose to extend the tramway from Trubshaw Cross to Highgate Inn, at Brownhills.

Calcutta.—Last month, at a meeting of the Calcutta Municipality, a motion postponing the decision on the electric tramways question was carried with practically no opposition. The mover's contention was, that those who were interested in promoting the company had already painted a roseate picture of its prospects. To do this they must have gone pretty deeply into the financial aspect of the scheme, and could, he felt sure, produce such a statement as would satisfy the Commissioners. The *Indian Engineer* says that another opponent of the scheme thought that the better plan would be to try gas traction, which would involve little expenditure, no risk, and afford somewhat of a criterion as to the probable results of electric traction.

Cardiff-Penarth.—The promoters of this tramway scheme, which has been sat upon by the Cardiff authorities, have now laid before the Cardiff Council a note of certain concessions and alterations which they are prepared to make in the scheme for the sake of securing the Council's approval. The Council adheres to its decision not to assent to the scheme.

Coventry Extensions.—The Stoke Parish Council has resolved to support the Coventry Electric Tramways Company's application for Parliamentary powers for extensions to its system, provided the company complies with certain stipulations regarding the shape of the overhead wire supports.

Halifax.—A special meeting of the Town Council, held last week, confirmed unanimously a resolution previously passed, applying for a Bill for the construction of tramways to be worked by electricity or other motive power. Alderman Booth, who seconded the motion, said that there was only one system for Halifax, and that was electricity. The committee has not yet considered the matter of haulage.

Large Rail Contract.—Leeds Corporation Tramways Committee, at their meeting the other day, had under consideration the question of renewing the rails on three of the tramway routes. It was finally decided, says *Daily Tenders and Contracts*, to relay the lines on the three sections in such a way that they can be used either for electric cars or for ordinary cars hauled by steam engines or horses. The committee do not bind themselves to adopt any particular method of haulage; all they do is to prepare themselves for a form that may be adopted. It is estimated that about 3,000 tons of rails will be required. The question of where these are to be purchased has been deferred to another meeting.

Paisley.—Mr. Teague's report recommends the high tension alternating current system, current to be distributed from the works at Blackhill at 2,000 volts, and by means of transformers to supply the distributing mains in the principal streets with current at 100 volts. The cost of the scheme is estimated at £33,750.

Sheffield.—It is now an open secret, says a London daily, that the committee appointed by the Sheffield Corporation to inspect the various methods of tramway traction, both on the Continent and in this country, will recommend the adoption in Sheffield of the overhead electric system. The nature of the report they intend to make shortly is being kept secret, but a prominent member of the committee has stated at a public meeting that he is strongly in favour of this method, because it is peculiarly adapted for the unusual conditions which prevail at Sheffield, and the same member states that the committee are unanimous in their recommendation.

Smethwick.—The Council will oppose the Birmingham, Wolverhampton and District Tramways Bill, and the City and Birmingham Tramways Bill.

Stockton.—At the last Corporation meeting the application of the Imperial Tramways Company to the Board of Trade for Parliamentary sanction to reconstruct and equip a tramway on the overhead electric system throughout the borough was discussed. The borough engineer (Mr. K. F. Campbell) said that the company sought to obtain power to replace the existing lines on the most modern principles, and to work the same electrically on the overhead trolley system. It was intended to reduce the present gauge to 3 feet 6 inches, in order that double lines might be constructed throughout the entire route. After a minute examination of the scheme, and a careful study of the various systems of mechanical traction obtained in other towns, he had come to the conclusion that electric traction under certain conditions was best suited to the wants of the public. He approved the overhead trolley system as the best for the ordinary streets, but as regards the High Street with its exceptionally wide dimensions, he thought that either the open conduit system or the accumulator system should be adopted, so as to obviate the necessity for poles in the roadway, and he pointed out that this could easily be arranged. He also suggested that the whole cross sections of the roads should be paved from channel to channel at the expense of the company. The Corporation should be empowered to purchase the electric plant and all other additional plant and works of the company at the end of a term of years to be agreed upon at its then value, without any allowance for compulsory purchase, goodwill, or other consideration. The company should afford facilities and allow the Corporation to use the poles for lighting purposes, and make their poles suitable for that purpose if desired.—The committee recommended that the application made on behalf of the intended new tramway company to construct tramways within the borough on the overhead system be assented to, except along the High Street, subject to terms as to wayleave, provisions as to purchase by the Corporation, rent, and to special conditions and stipulations as to traction and other matters, the same to be embodied in an agreement to be entered into between the promoters and the Corporation before January 8th. They also appointed a sub-committee, Alderman Samuel, M.P., Alderman Hind, and Councillor Appleton, to confer with the other authorities interested as to the best course to be adopted, and also to formulate the conditions to be exacted from the company.—The minutes, with the exception of the first recommendation of the committee, were then put and approved.—The Council afterwards went into committee to consider the special motions of which the Mayor had given notice, and which were as follows:—"That in the event of satisfactory terms not being arranged with the Imperial Tramway Company, the District Joint Committee be authorised to lodge with the Board of Trade notice of objection to the proposals of the company; also, that the District Fund Committee be authorised to confer with the committees appointed by the neighbouring local authorities in the appointment of a suitable electrical engineer to advise as to the proposals of the tramway company, as to the stipulations and conditions which should be sought to safeguard the authorities concerned, and to advise generally in the situation."—The former portion of this motion was agreed to, but that suggesting the appointment of an engineer was left out.

The Electric Line to Ramsey.—We understand that the extension of the Douglas and Laxey line to Ramsey will be finished by midsummer.

Wellington (N.Z.).—Mr. John Gell, of the Telegraph Department, has submitted a statement on electric tramways to the Mayor. Mr. Gell, a couple of years ago, visited Europe and America, and says that he gave a good deal of attention to the subject of electric traction. He declares that the present system of tramways in Wellington is obsolete, and the Corporation should not purchase it at any price. The trolley system of electric traction he considers the most suitable for Wellington. To replace the present tramways, he estimated the cost would be £45,000, and with extension to the suburbs the total cost would be about £100,000. He estimates that on a 1d. and a ½d. passenger rate the annual profit would be £3,500 on the city lines.

Wolverhampton.—At the Town Council the other day a discussion took place with regard to the action of the Tramways Committee appointed to consider the action of a company promoted to purchase the tramways in the borough, and it was decided that the committee be authorised to memorialise the Examiner of Standing Orders complaining that they had not been complied with; and further to present a petition against the Birmingham, Wolverhampton, and District Tramways Bill, which is now being promoted in Parliament, in default of satisfactory terms being arranged between the Tramway Committee and the promoters of the Bill, necessary for the protection of the rights and interests of the Corporation relative to the tramways within the borough. The Rowley District Council also disapproves of the Bill.

TELEGRAPH AND TELEPHONE NOTES.

Telegraphic Interruptions and Repairs:—

CABLES.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1895 ...	...
Puerto Plata-Martinique ...	Dec. 19th, 1895 ...	...
Amazon Company's cable—		
Parintins-Itacatiara ...	May 5th, 1896 ...	...
Obidos-Parintins ...	Dec. 7th, 1896 ...	...
Maranham-Ceará	Dec. 2nd, 1896 ...	...
St. Croix-Trinidad	Nov. 30th, 1896 ...	...
Mozambique-Lorenzo Marquez	Dec. 24th, 1896 ...	...
Hong Kong-Macao	Jan. 5th, 1897 ...	...
LANDLINES.		
Trans-Continental line beyond Masol	March 12th, 1896 ...	...
Carthagena - Barranquilla (Columbia)	July 4th, 1896 ...	...
Salisbury-Umtali	July 11th, 1896 ...	...
Saigon-Bangkok	Jan. 8th, 1897 ...	Jan. 8th, 1897.

December 5th, 1896.—Katarina-Larissa route working badly.

January 8th—11th.—Telegraphic communication interrupted at Port Darwin owing to hurricane.

Australian Landlines Again Interrupted.—Concerning this familiar subject, we reproduce a note from an Australian journal, dated November 30th last:—"Communication with Yardea, a station on the new telegraph line to Western Australia, having been interrupted by a storm, it is impossible to ascertain whether the wire to the flagstaff landing has been connected. It was expected that communication would have opened with Western Australia over the new line two days ago, but the atmospheric disturbance on Wednesday night is supposed to have interfered with the completion of the line." From a telegram dated from Melbourne on the 7th inst., we learn that in consequence of a severe hurricane at Port Darwin, telegraphic communication was interrupted. A further press telegram states that on the 9th communication was restored. Again we wish to record the fact that the International Telegraph Office at Berne has not sent to all concerned a notice of the above interruptions. Clearly there is someone at fault in this neglect.

New Cable.—The number of telegrams sent over the new Emden-Vigo submarine cable connecting Germany and Spain during the fortnight that it has been in operation amounted to 4,671.

News?—Berne notice of January 4th, inadvertently delayed at the Post Office until the 11th inst., states that all Atlantic Companies now accept telegrams for the West Indies and South America routed *viâ* the New York-Haiti cable at the same rates.

The Telegraph Wire Export Trade.—Although December proved to be a much more active month in the export trade of this country in telegraph wire and apparatus connected therewith than the one immediately preceding it, yet there is not the same activity prevailing as was noticeable a year ago. This will be seen from the following figures:—Exports: December, 1896, £118,720; November, 1896, £48,371; December, 1895, £296,145. The total exports during the whole of 1896 show an improvement of £84,621 over 1895, having amounted to £866,996 as compared with £782,375 in the earlier year. They are, however, considerably below the exports during 1894, during which year they amounted to £1,386,614.

CONTRACTS OPEN AND CLOSED.

OPEN.

Blackpool.—January 15th. The Corporation invites tenders until to-day for an installation of the necessary fittings, lamps, and apparatus for the electric lighting of the new Municipal Buildings.

Bristol.—January 21st. The Electrical Committee want tenders for five Lancashire boilers for the electric light station.

Edinburgh.—January 28th. The Managers of the Royal Infirmary are inviting tenders for the complete wiring of the Infirmary buildings. Particulars from the treasurer and clerk (Mr. W. S. Caw), or Prof. Kennedy, 17, Victoria Street, S.W.

France.—January 19th. Tenders are being invited by the French Post and Telegraph Authorities in Paris for the supply of two lots of iron pipes 80 mm. internal diameter for pneumatic lines. Tenders to be directed to the Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

France.—January 21st. The French Post and Telegraph Authorities in Paris are inviting tenders for the supply of 103,745 creosoted telegraph poles. Tenders to be sent to the Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

France.—January 28th. The French Post and Telegraph Authorities in Paris are inviting tenders for the supply of 6,000 galvanised iron screws, and 25 tons of bronze wire. Tenders to be sent to the Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

France.—January 31st. Tenders are being invited until January 31st next, for the contract for an installation of electric lighting in the Asile d'Aliénés at Saint Jvon (Seine Inférieure).

Hull.—February 1st. The Corporation of Hull is prepared to receive tenders for a lease of the tramways authorised to be constructed by the Tramways Orders Confirmation (No. 1) Act, 1,896.

Jamaica.—April 15th. The Privy Council invites applications for a license for the establishment and working of a system of rapid transit in Kingston and environs. Copies of the Tramways Law, 1895, and of local rules and maps of Kingston and environs may be seen at the offices of the Crown Agents for the Colonies, London.

Morley.—January 19th. The Corporation is inviting tenders until Tuesday next for the erection of engine and boiler houses, offices, chimney stack, &c., for electric light works in Fountain Street. Consulting engineer Mr. Robert Hammond.

Portsea.—January 20th. The Portsea (Portsmouth) Island Union is inviting tenders for electric lighting and hot water and engineering work at the new infirmary buildings, Union House, Milton. Particulars of C. W. Bevis, architect, Elm Grove Chambers, Southsea.

Scarborough.—January 20th. Tenders are wanted for lighting the corridors and rooms of Cambridge Hotel, South Cliff, with electricity. Particulars obtained at the Hotel.

St. Pancras.—January 26th. The Vestry wants tenders for supplying and laying earthenware conduits, lead covered armoured cables, and bare copper strip conductors in culverts. Particulars at the Electricity Department Offices, 57, Pratt Street, N.W. See our "Official Notices."

Wallasey.—February 18th. The District Council invites tenders for the supply and erection of a 200 kw. alternator with engine combined and for the requisite switchboard extensions. Particulars on application to the engineer, Mr. J. H. Crowther, the Great Float, near Birkenhead. See our "Official Notices."

CLOSED.

Harrogate.—We understand from a daily contemporary that the Corporation has given the contracts for wiring the public buildings as follows:—Victoria Baths and Municipal Offices, G. H. Steinthal, £321; Market Hall, Paterson & Cooper, £148 7s.; Free Library, C. O. Dawson, £64 17s. 6d.

NOTES.

"The Surveyor."—Last Friday's issue of this paper was a special number, and contained a forecast of the municipal works to be carried out by local authorities during the year 1897.

Electric Power Transmission in the States.—We hear that it is proposed to utilise the forces of the St. Lawrence River for developing electric power to the amount of 100,000 H.P., or more. The water will be utilised at Massena, in St. Lawrence county, about 40 miles south-west of Montreal. The St. Lawrence River and the Grass River run almost parallel for some distance, only being about 3½ miles apart. For a certain distance before Massena is reached the St. Lawrence falls 100 feet, and the Grass River only 50 feet, so that all that is required to procure a 50-feet fall at Massena is a canal from the St. Lawrence to the Grass River, 3½ miles in length by 200 feet wide. The Grass River conveys its waters into the St. Lawrence about seven miles further down. A canal of these dimensions would give 100,000 horse-power, being capable of carrying 1,000,000 cubic feet of water per minute. Mr. John Bogart, consulting engineer of the company, has placed the cost of the canal for developing 100,000 horse-power at less than a million dollars, which means an installation cost for water power of $10 per horse-power. The present outlook is, that the power will be nearly all used on the spot. Wood pulp mills will take a considerable share of it, but it is extremely probable that 50,000 or 75,000 horse-power will be required for the manufacture of electro-chemical products. Lieut. F. Jarvis Patten, who is now at work designing the power plant, proposes to instal 10,000 H.P. dynamos connected direct to the spindles of turbines of that output, which, under the comparatively low pressure used, will involve but little difficulty. The promoters of this new and highly important power enterprise are Messrs. Stewart & Co., of New York.

Light Railways.—The *Engineer* points out that though in 1896 there was a commission appointed to deal with railway proposals, so as to save the time and expense of the hitherto existing methods, yet the prognosticated rush of light railways has not occurred. Only some 300 miles have so far been proposed in about 28 applications. Intended for farmers, events show no purely agricultural line, unless one of 26 miles, from Saltfleetby to Grimsby, can be so considered, and one of Sir W. Gilbey's, from Elsenham to Bradfield, of 2 feet 6 inches gauge, 11 miles long. Then there is an agricultural line from Basingstoke to Alton, to be constructed by the South-Western Railway, and will really be a link between the two main lines of that company. Our contemporary urges that the railway companies will build under the new Act, and seems to foresee trouble on this score, the term light railway being open to a very wide interpretation. This country has been deprived of light railways by a careful Board of Trade, which has not been able to see, and has therefore not provided for it, that the allowable speed must always be the factor determining the absence, or otherwise, of safeguards. As it is, safeguards have been laid out upon a supposed 60 miles per hour velocity, and yet there are doubtless many very favourable routes for light railways making a maximum of 15 miles. The experience of American electrical lines, however, has been against light construction of track, and the use of too light a rail is to be deprecated, even on light railways.

A Record Year at the Patent Office.—The number of applications for patents filed in the British Patent Office during 1896 amounts to 30,165, an increase of over 5,000 on the number of applications in 1895. Messrs. W. P. Thompson and Co., the International Patent Agents, report that very great inventive activity was displayed in relation to velocipedes and motor cars and appliances, as also in inventions relating to lighting by means of electricity, gas incandescence, acetylene, and so forth. In foreign countries the chief events of the year, in connection with patents, have been the promulgation of a new law in the Russian Empire embodying important concessions to inventors, and the extension by Japan of the benefit of its patent laws to British and other subjects.

Recent Results with the Electric Furnace.—Henri Moissan, whose researches in connection with the electric furnace we frequently have to chronicle, finds that important alloys can be obtained by taking advantage of the ease with which metallic oxides are reduced by aluminium. His general method appears to be to bring aluminium into a molten condition, and then to throw into it a mixture of aluminium fillings and of the oxide of the metal which it is desired to alloy. A further energetic development of heat takes place, with the result that the most refractory oxides are reduced. By means of this method Moissan has succeeded in preparing alloys of aluminium with nickel, molybdenum, tungsten, uranium, titanium, and chromium. The advantage of mixing tungsten, &c., with steel, is well known, and Moissan states that not only this substance, but titanium also, can be introduced into Siemens-Martin steel (*vide Comptes Rendus*, 1896, Vol. 122, page 1,302). Many chemical substances, when heated in the electric furnace, give some very astonishing results, and in some cases they become transformed into minerals, which up to the present have only been met with in Nature. A. Mourlot finds that amorphous lead sulphide, when heated in the electric furnace for eight minutes with a current of 35 volts and 15 amperes, yields crystals of galena; with stronger currents, metallic lead alone is produced. Antimony sulphide behaves in a similar manner, yielding stibnite and the metal, whilst the amorphous zinc sulphide yields wurtzite and cadmium sulphide and greenockite (*vide Comptes Rendus*, 1896, Vol. 123, pages 54 to 57). Referring to Moissan's results, Charles Combes states that better success can be obtained with less loss, by adding the sulphide or chloride of the particular metal to the fused aluminium. In the first case, the aluminium sulphide rises to the surface of the metal, whilst in the second the aluminium chloride volatilises (*vide Comptes Rendus*, 1896, Vol. 122, pages 1,482 to 1,484). Pure tungsten may now be obtained by heating a mixture of tungstic acid with sugar carbon in the electric furnace, the heating being continued for 10 minutes with a current of 900 amperes and 50 volts (*vide Comptes Rendus*, 1896, Vol. 123, page 13). The metal vanadium can be obtained by means of the electric furnace in a condition of tolerable purity by heating a mixture of vanadic anhydride with sugar carbon for five minutes, with a current of 900 amperes and 50 volts. The impurity consists of carbon. A carbide having the composition V.C. is also obtained by mixing the above substances and heating them for nine or 10 minutes in the carbon tube of an electric furnace (*vide Comptes Rendus*, 1896, Vol. 122, pages 1,297 to 1,302). It has been found by Moissan that rhodium, iridium, and palladium, when heated in the electric furnace in the presence of carbon, actually dissolves a small quantity of the latter. The metals become harder, and lose their malleability (*vide Comptes Rendus*, 1896, Vol. 123, pages 16 to 18). G. J. L. le Charmot, by heating a mixture of silica, lime, and carbon, succeeds in obtaining a large proportion of crystalline silicon. The upper electrode is made the cathode, and the furnace is of the upright form (*vide* the *American Chemical Journal*, 1896, Vol. 18, pages 536 to 540). Metal uranium has been prepared in the electric furnace by the action of sodium on the double sodium uranium chloride in an iron tube, also by the electrolysis of the fused double chloride with carbon or iron electrodes, and a current of 8 or 10 volts and 50 amperes (*vide Comptes Rendus*, 1896, Vol. 122, pages 1,088 to 1,093).

Obituary.—We regret to hear of the death, which occurred on January 4th, in London, of Mr. George Seymour, M.I.C.E., A.R.S.M., of Bainbridge, Seymour & Co., a prominent man in the mining world. Mr. Seymour was a President of the Institution of Mining and Metallurgy, and was also actively connected with various other mining societies. He was only 48 years of age at the time of his death.

St. Helen's Tramways.—It is rumoured that the officials of the local tramway service are so much impressed with the value of electrical working, that it is not at all unlikely that the Corporation may be asked to supply electricity for working the tramways on the basis of ⅜d. per unit. The present trams are worked by steam engines, and the expenses per car mile for 1895 were 9·89d., the percentage of expenses to receipts being 77·44.

The Institution of Junior Engineers.—On Friday next, January 22nd, at 8 p.m., at the Westminster Palace Hotel, a lecture on "Comparisons of Similar Structures Large and Small," will be delivered by Prof. A. Barr, D.Sc., of Glasgow, Hon. M.I.J.E. The following night, Saturday, January 23rd, 6.30 p.m., at the Westminster Palace Hotel, will be the Twelfth Anniversary Dinner, the President, Mr. A. R. Binnie, M.Inst.C.E., in the chair.

Electro-Chemical Works.—A company at Warsaw is erecting works between Zombkowic and Strzemieszyce for the electrolytical production of bleaching powder and caustic soda.

New works for the production of chlorate of potash by electrolysis have just been completed and put in operation at Saint Gervais (Savoy).

Electrolytic Decomposition of Fused Zinc Chloride.—Attention should be called to a paper by Richard Lorenz, in the *Zeitschrift für Anorganische Chemie*, 1896, Vol. 12, pages 272 to 276. A determination of the voltage required to decompose pure fused zinc chloride gives the number 1·49 to 1·50 volts. Three different strengths of current were employed in the experiments, and the results obtained from each agree closely. The theoretical voltage = 2·1, but it must be remembered that the temperature at which the experiments were carried out was 500° — 600°.

The Truth about Dr. Lardner.—We reproduce the following interesting communication from the New York *Electrical Engineer*:—

I find the following at the end of a paper on "Telephone Repeaters," by Mr. Thomas D. Lockwood, in the *Electrical World*:—

"The versatile and brilliant writer and lecturer, Dionysius Lardner, while proving it to be absolutely impossible for any ship to carry coal sufficient in amount to enable it to cross the Atlantic by steam power, was confuted by the news that the feat had just been performed and that a steamer had arrived."

This statement has been disproved so many times, and it has been so long recognised as a baseless slur on the memory of one of the ablest popularisers of science who ever lived, that when Mr. Lockwood repeats it, it can only be inferred that he has found some new evidence to substantiate it; and I venture to express the hope that this will be soon forthcoming.

In the meantime, it may be pointed out that at the Bristol meeting of the British Association for August 25th, 1837, at which it was alleged Dr. Lardner formally asserted the Atlantic steam voyage to be impracticable, two opposing projects then before the English public were under discussion; one being for a line of steamers between the west coast of Ireland and Boston, touching at Halifax; the other for a line direct between Bristol and New York. Lardner strongly favoured the first and deprecated the second, because he believed that an unbroken voyage in the existing state of knowledge of steam engineering would not be found as profitable as one made in successive stages.

With singular prescience, he had added to the original suggestion of the Boston-Halifax line the idea of a railway from the Irish terminus to Dublin, and steamers from Dublin to Liverpool connecting with the Liverpool, Birmingham and London Railway, so that the whole route, as he said, "would form one great continuous steam highway between the Capitals of the New and Old World." Such a line, he further insisted, would secure the contract for the British mails, the profits from which would counterbalance the losses due to lack of travel during the winter season.

When the discussion came up, Dr. Lardner said (London *Times* report): "If there was one point in practice of a commercial nature which more than another required to be founded on experience, it was this one of extending steam navigation to voyages of extraordinary length." He was aware that since the question had arisen in that city it had been stated that his own opinion was adverse to it; that impression was wrong; but he did feel, as steps have been taken to complete this experiment, great care should be used in the adoption of means for carrying it into effect." Then he went on to advise the use of the best coal, to indicate what he thought the best ratio of power to tonnage, to recommend copper boilers, and the placing of coal in tanks, and, finally, after more discussion, he reiterated that he "thought the voyage practicable, but he wished to point out that which would remove the possibility of a doubt, because if the first attempt failed, it would cast a damp upon the enterprise, and prevent repetition of the attempt."

The charge which Mr. Lockwood repeats against Dr. Lardner had hardly gained publicity before it was immediately refuted, again and again in England, and later, in this country, when Dr. Lardner lectured here.

It was a suggestive example of the fate which is generally in store for the scientific person who dares to say what he believes, even if it be contrary to the interests of the promoters of an opposing scheme. The promoting tribe in 1837 was no different from its descendants of to-day, and it dealt with Dr. Lardner in that same kindly spirit, and with that perfect Christian consideration, which has always characterised certain modern monopolies in dealing with those who have ventured to criticise either their alleged rights or wretched service.

PARK BENJAMIN.

New York, *December 2nd.*

Prizes for Motor Vehicles.—The Royal Agricultural Society announce that they will award prizes at the June meeting of the Society, to be held at Manchester this year. Two classes will be judged—light and heavy—and a first prize of £100 and a second of £50 will be given in each class. The light class is supposed to contain vehicles suited to carry loads up to 2 tons, exclusive of the vehicle itself. The heavy class similarly will be equal to loads of 4 tons. All the vehicles of necessity are to be entirely self-moving vehicles worked by oil, must conform to the "Regulations as to Petroleum" under Section 5 of the Locomotives on Highways Act of 1896, and vehicles otherwise must conform to Section 6 of the same Act, but may be in all other respects made to the design of the manufacturer. Competing vehicles will be tested when carrying a declared weight over a course of 50 miles out and home again, and the consumption of fuel and water, speed, &c., will be recorded, and the maximum speed must be in accordance with the regulations of the Local Government Board. The judges will also demand such further trial as they may think necessary, such as hill climbing, and in making their awards will consider the public convenience, ease of handling, stopping, starting, steering, economy, price, strength and simplicity of design, and where oil is used, the flash point will be considered. The motor car in any form is not yet very common. We saw one a few days ago running very nicely past Charing Cross, but were too far off to distinguish its motive power. Its steering was excellent, however, and so far we can only say that this point of steering has appeared to give very little trouble. The scarcity of motor cars is evidence that much of the hubbub raised of late has been simply so much attempted booming. The motor car is bound to put in a good appearance before long. Everyone cannot keep a horse. Many who could afford to do so would be at a loss to look after it. People in the country who only need their traps in fine weather would prefer the motor car to the horse, on account of its greater cheapness when idle. Travellers in the southern counties are bound to have them. Sir David Salomons believes in them. He is a director of the S.E. Railway, we believe, and has lately written to the *Engineer* to say that his railway is to be brought up to the standard of the northern lines. He says by degrees, from which we are to infer it will be a process of time. At the present rate of progress the motor car will win the day, and perhaps the improvements on the S.E. Railway will be too late after all. What is wanted to popularise the motor car is not altogether a high flyer of a car of expensive build, but some cheaper form that will make a fair speed up most hills, though not necessarily very fast on the steeper grades.

Philosophers and Units of Force.—While the columns of *Nature* still offer a field for the tilting matches of professors, the *Engineer*, which is held up by Prof. Lodge as a terrible example of engineers' shortcomings, asks plaintively whether engineers can do otherwise than go along in their own blundering way, when the professors of all knowledge are falling out among themselves, and one cannot really tell what is the proper course to follow. Between the Scylla of Lodge and the Charybdis of Perry, the channel is so very narrow that one may well miss it. When the negro parson would point the way of salvation, he told his hearers they had choice "ob two ways, de broad and narrow way leading to destruction, and de narrow and broad way leading to eberlasting damnation." As with one of his sable hearers, the only choice of the engineer who would avoid the professorial pit is "to take to de woods." Our contemporary, however, does not exactly take to the woods, but hints with considerable directness that the professors themselves are not very clear as to the meaning of terms and definitions. As with the geologists every professor is a law unto himself, and will allow no other man to have a show, and we suppose it were hopeless to suggest a conference of professors for the purpose of laying down hard and fast rules upon disputed points. We venture to suggest that the expenses would be amply covered by a small admission fee for the public to witness the fray, and the return tickets to their homes of most of the disputants would be saved if a sufficient number of material standards of weight and mass were to hand for the heaving, which we expect would break up the society much in the manner of that upon the "Stanislaw," in a scene of sin.

An Italian Institution of Electrical Engineers.—La Associazione Elettrotechnica Italiana is the title of a new society which has just been formed in Milan. Prof. G. Ferraris, of Turin, has been elected the first president, with Prof. G. Colombo, of Milan, and Prof. G. Mengarini, of Rome, as vice-presidents.

Isolated Electric Plants for Country Residences.—In another place we reprint from the *American Electrician* two articles on the subject of isolated plants for country residences, which will repay careful perusal by our readers. The articles, says our contemporary editorially, refer to plants in operation, giving the various details of installation and operation, and lay down in general form the principles which should be observed in the design and installation of such plants, and also give valuable information on the care and management of storage batteries. It should be remarked that while with a properly designed plant of the above character expert attendance is not necessary in its operation, it should be inspected at definite intervals by an expert. In justice to themselves, consulting engineers and others drawing up specifications for a plant, should include a clause providing for such inspection. Otherwise it is likely to be not done, whether through neglect, supposed economy, or reluctance on part of the attendant to subject his stewardship to criticism. As part of a country residence electric lighting plant, a storage battery should be considered indispensable. A plant without this appendage would, almost undoubtedly, be found in time so unsatisfactory as to cause it to be thrown out, or lead to the addition of a battery under circumstances as to proper installation, less favourable than if it were included in the orginal plans. One of the advantages of the addition of a storage battery that should not be lost sight of, is that it involves a generating plant of smaller capacity than if the lighting were dependent on the dynamo alone. By connecting the lamps on two circuits, these can ordinarily be run together from the battery, and separated on special occasions when there is an abnormal demand for light, one circuit being then fed direct from the dynamo. The addition of a wattmeter is also advisable, which may be so connected that when switched on the charging circuit, a shunt diverts a portion of the current corresponding in amount to the storage loss, thereby rendering the battery charging and discharging readings equivalent to each other.

Superheated Steam Experiments.—The chief engineer of the Alsatian Association of Steam Users issues many excellent reports. In his description of boiler working for 1895, he mentions a badly-attended boiler whose flue gases contained only 5·3 per cent. of CO_2 to 13·2 per cent. of excess oxygen. Under better conditions, the percentage of CO_2 was raised to 9·67, and the excess of oxygen fell to 7·23. This change represented an increase of 35 per cent. in efficiency of the boiler. In testing a compound engine with 3° of superheating, the mean pressure of steam supplied was 5·7 atmospheres. Heated 42° to 222° C., 10·5 per cent. of economy was secured with a saving of 8 per cent. in fuel. Raised 84° to 264°, and the two economies were 14·3 and 14·4 per cent., while with 100° superheat, or a temperature of 284°, the economies were 19·3 and 20 per cent. The steam lost 17° C. in the steam pipes at the lowest heat, and 21½° at the maximum temperature. As the superheating increased, the steam consumption gradually fell from 16·5 lbs. with saturated steam to 13·2 lbs. at 100° of superheat. Another compound engine, also of about 700 I.H.P., was tested with saturated steam, and gave a horse-power with 14·3 lbs. of steam. Coal used was 1·56 lb., and 1·94 lb. water was evaporated per square foot of heating surface per hour. A smaller engine of hardly 200 H.P. showed 16 lbs. and 14 lbs. of steam per hour, when working with steam at 5·8 and 6·8 atmospheres. These figures included the jacket water. This engine was, therefore, underloaded at 151 H.P. during the first test, for it gave 194 H.P. at the second test, with only seven-eighths the water consumption. Superheat 100°, and save 20 per cent., may be laid down roughly as the practice in superheating. Mr. Walther Meunier thus confirms the recognised opinion that the economy of superheating is out of all proportion better than the mere paltry few additional units would thermally warrant one to suppose could be the case.

Lectures.—Mr. James Swinburne, M.Inst.C.E., commenced a course of lectures upon "Dynamo and Transformer Construction" to the senior students of the Electrical Standardising, Testing, and Training Institution, yesterday.

On 6th inst., Mr. George Balfour, Dundee, delivered a lecture on "Electric Light," in the Public School at Monifieth. He had calculated what it would take to light up a burgh such as Monifieth with electric light. Allowing for the interest on the necessary capital, expenditure, and the working expenses, he showed a yearly outlay of £551. Calculating for 60 street lamps and 600 private lamps, the electric light could be introduced into Monifieth at a rate similar to gas at 6s. per 1,000 feet.

At the Finsbury Technical College, the Wednesday evening lectures by Prof. Silvanus Thompson during the present term are on "The Design and Construction of Electro-Magnets." The advanced course on Mondays is to be given to "Alternating and Polyphase Currents," commencing January 18th. The special laboratory course in "Electroplating and Typing," by Mr. Rousseau, also begins next week.

Conversazione. — The annual conversazione of the Birmingham and Midland Institute was opened on 12th inst. One of the attractions was an exhibit of Röntgen ray apparatus and demonstrations thereof were given by Mr. Hall-Edwards. Tesla high tension and varied scientific apparatus were among the exhibits.

Acetylene.—At a recent meeting of the Nottingham section of the Society of Chemical Industry, Dr. Frank Clowes read a paper on the limits of explosibility of mixtures of acetylene with air, and the detection of small proportions in air. The greater part of his paper, which was certainly an important one, is chiefly interesting to chemists, and for our purpose may be overlooked. Some interesting matters, however, were brought into the discussion which followed the reading of the paper. Dr. Clowes found that air containing any percentage proportions between 3 and 82, gained the power of burning throughout independently of the external atmosphere. This is a far wider range than that shown by any combustible gas yet experimented with, and it appears probable that the wideness of the range of explosibility, due to true combustion, is, in the case of acetylene, increased by its known power of undergoing endothermic decomposition. It seems that a great many acetylene explosions have taken place, especially on the Continent, where there are already a great many types of acetylene lamps. These, according to Prof. V. B. Lewes, have, at any rate in some instances, been due to the presence of phosphide of calcium in the carbide, which contained much impurity owing to the use of phosphatic lime in its manufacture. Such carbide evolves phosphuretted hydrogen on contact with water, which is capable of firing an explosive mixture of acetylene and air. In a letter to the *Journal of Gas Lighting*, Prof. Lewes made the following significant remark: "The present manufacture of acetylene from impure carbide, and the sale and use of automatic acetylene generators utterly unfitted for the purpose for which they are intended, is fraught with very great danger; and I fear that in the next few months you will have to record many accidents." The danger attending the indiscriminate use of the carbide has also been referred to recently by the well-known French chemist, Emile Gautier, in an article in the *Figaro* on the domestic uses of acetylene. He said that whilst the danger attached to trying experiments with small quantities is so little as to be negligible, it was quite another matter when it came to using large quantities. He went on to say: "To put water on to a mass of carbide equal to a dozen kilogrammes, would be like lighting a cigar in a powder magazine." He seems to think that the only rational way to use acetylene is in its liquid form. In connection with this Raoul Pictet, it may be noticed, has devised a chemical means of purifying acetylene and delivering it in a liquid form for use. We believe, also, that he has devised a method of using the solid carbide, which is alleged to be free from the danger of explosion. Very shortly pure liquid acetylene will be sold in France, in cylinders, as compressed gases are now delivered in this country. It was also stated in the discussion, that so far, acetylene lamps on the Continent had not been very successful. Sometimes the lamp would burn for an hour and sometimes for an hour and a half, and then would not burn again until they had been recharged. Usually the apparatus generated the gas much faster than it could be burnt, thus leading to dangerous and offensive pollution of the air. A special jet must also be used, otherwise there is a danger of the gas lighting back. This will not happen in a cool tube, but it will if the tube is hot. The friends of acetylene are certainly making more active efforts to push its sale in France than they are in this country, as instance the incident that when walking down the Boulevard des Italiens a month or two ago, the writer was three times gratuitously presented with copies of a little paper entitled *L'Acétylène*. This is a little four-page paper, which is termed the *Organe Spéciale des Applications du gaz Acétylène*, and comes out every Sunday. It contained short articles on acetylene, and the manner of using it, and was conspicuously free from puff.

Bohemian Concert.—A concert on an immense scale was given on Wednesday last by the staff and employés of the National Telephone Company. The great hall at the Cannon Street Hotel was crammed to overflowing, the entertainment being presided over by Mr. C. B. Clay, with Mr. C. J. Phillips, as vice-chairman. Lord Harris, the vice-president of the company, supported by his presence the chairman of the evening. A very lengthy programme was gone through, and a very enjoyable evening was spent.

A Patent Museum.—With reference to Mr. J. Sinclair Fairfax's proposal, we believe that no positive objection is expected from the Board of Trade or the Patent Office authorities. We understand that the London Chamber of Commerce has been asked to co-operate. Might not the Electrical and Allied Trades Section of that Chamber also render assistance in this matter?

The "Blot" Accumulator.—A demonstration of the "Blot" accumulator was made at the Hotel Cecil on Tuesday last, before a large audience. Mr. H. T. Cheswright expatiated at considerable length on the properties of the cell, and quoted the opinions not only of such eminent men as Mr. Preece and Dr. d'Arsonval, but of persons who had used the accumulator for a prolonged period. After setting forth the principal features of the cell, some views of the French works were projected on to the screen, and by the aid of these the process of manufacturing the plates was clearly shown. The capabilities of the cell for heavy discharges were then exhibited by charging one cell, and discharging it at a high rate, but any such tests on one cell are perfectly useless as a guide to the performance of the "Blot" accumulator in bulk. It is unnecessary to say anything about its construction, for it was fully described and illustrated in the ELECTRICAL REVIEW of February 14th, 1896. A company has been formed to exploit the accumulator, and the prospectus may be expected in a few days. If the "Blot" cells can stand the rough usages of traction, which only the lapse of time can practically demonstrate, it has, doubtless, a very wide field of application before it in competition with others. With reference to Mr. Preece's figure of 12·7 ampere-hours per kilogram of plates, *i.e.*, 5·8 per lb., it is quite valueless to quote this without stating the rate of discharge and total weight of cell, or the rate of discharge and the time it is spread over. But let us say a few words concerning the Faure-King cell. Taking a usual standard size, viz., a nine-plate cell, we find that the total weight of plates is 25½ lbs. The output given in the E.P.S. Company's list is 150 ampere-hours at 30 amperes, or as nearly as possible 5·9 ampere-hours per lb. of plates. As a matter of fact, when a test discharge is taken, this capacity is easily raised by 10 to 15 ampere-hours, which brings out the yield as somewhat over 6 ampere-hours per lb. of plates. The rate of 2½ amperes per lb. of *positive* plate, to which Mr. Cheswright draws attention, is not in any way excessive; it is the ordinary listed rate for the Faure-King plates. Comparing the figures, we see that the Faure-King cell has a slight advantage, even according to its listed output, so it is not easy to see how, quoting from Mr. Cheswright's published statement, "with M. Blot's system we have even a much higher capacity than with any industrial oxide accumulator known."

Personal.—Mr. H. L. Leach informs us that he has resigned the position of resident and superintendent engineer of the St. James's and Pall Mall Electric Light Company, Limited, and has joined the staff of Mr. F. J. Warden-Stevens, 34, Victoria Street, Westminster.

The Russian Academy of Science has elected Lord Kelvin an honorary member, and Lord Rayleigh and Prof. Bury, of Dublin University, corresponding members.

The Economy of Electric Motors.—The great economy of the electric motor has been insisted upon over and over again in these columns. The incident of the great saving effected at the works of Messrs. Dorman & Long, of Middlesbrough, has become almost historical, and there have been many other instances since then. One of the latest, however, is the case of the bleach works of Messrs. A. J. King & Co., of Bollington, whose system of electric motors was laid out by Messrs. Mather & Platt, and described in the ELECTRICAL REVIEW of July 3rd, 1896. It has been found that for 12 months electrical working the saving has been close upon £200.

The Institution of Electrical Engineers.—At a Students' meeting on Wednesday next, January 20th, at 7.30 p.m., a paper will be read by Mr. B. Hopps, "Experiences in a German Workshop."

North-East Coast Institution of Engineers and Shipbuilders.—A meeting will be held in South Shields on Wednesday, February 10th, 1897, when a paper on "Liquid Fuel" will be read by Mr. Robert Wallis.

Royal Institution.—On Tuesday next Dr. Waller will commence his series of lectures on "Animal Electricity," which will be delivered on Tuesdays until April 6th.

Awards.—As the result of the recent scholarship examination, the following awards have been made by the Board of Control of the Electrical Standardising, Testing and Training Institution:—To Laurence J. Kettle (Dublin University), a Maxwell Scholarship, value 50 guineas, tenable for two years; to C. J. Simeon (Cheltenham College), an Exhibition, value 30 guineas, tenable for two years; to S. W. Humphery (private tuition), a prize of 10 guineas.

Accident.—While engaged pulling down premises for the erection of the generating station for the new Central London Electric Railway to Shepherd's Bush, four men were injured (two seriously) by a falling wall.

The City and Guilds of London Institute.—We have received a copy of a report on the above Institution, drawn up by order of the Governors in consequence of an anonymous pamphlet entitled: "Is the Central College of the City and Guilds Institute for the Advancement of Technical Education a Failure?" We shall probably pay some attention to this matter in our next issue.

The Ayr Engineer.—We understand that Mr. Ernest G. Pink, the Corporation electrical engineer at Ayr, has resigned. He has had anything but a smooth time with the Council.

A Method of Making Peroxide of Lead.—The litharge or the sulphate of lead which is obtained from vitriol tanks can be used in the preparation of peroxide of lead by the following process, which has been worked out by H. N. Warren, and is given in the *Chemical News*, 74, page 144, The litharge or the sulphate of lead is placed in canvas bags, and packed round a sheet of lead previously inserted in each bag. Thus prepared, the bags are then placed in weak vitriol, and connected electrically with sheets of iron. The result of this arrangement is that the lead compound which the bags contain is very quickly reduced to the condition of spongy metallic lead. When this has been effected, the bags are connected alternately by their lead plates, and exposed to the action of an electric current, with a result that the positives are then completely converted into peroxide of lead, whilst the temporary accumulator thus produced is again emptied of its current into further quantities of spongy lead, thus producing a further quantity of peroxide. It is claimed that this process yields an absolutely pure peroxide at a low cost.

NEW COMPANY REGISTERED.

"Blot" Electric Accumulator Company, Limited (50,768).—Registered January 5th with a capital of £160,000, in £1 shares, to acquire certain patents and inventions, a factory, and other premises at Boves and Paris, France, and the business of an electrical engineer and manufacturer, carried on by G. R. Blot, to adopt an agreement with him, and to carry on the business of electrical engineers, electricians, accumulators, manufacturers, &c. The subscribers (with one share each) are: G. R Blot, 33, St. Swithin's Lane, E.C., engineer; H. T. Cheswright, 33, St. Swithin's Lane, E.C., electrical engineer; J. J. Thomas, Kestrel Avenue, Herne Hill, secretary; B. A. Elkin, Savoy Mansions, Savoy, W.C., solicitor; R. Dixon, Savoy Mansions, Savoy, W.C., solicitor; R. E. Dixon, Heath Lodge, Twickenham, solicitor; W. J. Savage, 93, Higham Road, East Ham, director. The number of directors is not to be less than five, nor more than 10; the subscribers are to appoint the first, except that G. R. Blot and H. Sheen can nominate one each; qualification, £250; remuneration, £150 each per annum (£250 for chairman) and a share in the profits. Registered by Dixon and Co., Savoy Mansions, Strand.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electrical Development and Finance Corporation, Limited (49,021).—This company's statutory return was filed on December 18th, when 10,227 shares were taken up out of a capital of £50,000 in £1 shares; 15s. per share has been called, and £7,605 10s. has been received, leaving £64 15s. unpaid.

Electrical Manufacturers, Limited (48,418).—This company's statutory return was filed on November 2nd, when 3,725 shares were taken up out of a capital of £5,000 in £1 shares; 2,500 are considered as paid, and £1 per share has been called. £750 has been paid, and £475 is in arrears.

Electrical Oil Refining Company, Limited (43,126).—This company's return was filed on December 24th, when 2,000 shares were taken up out of a capital of £5,000 in £1 shares; 1,493 are considered as paid, and £1 per share has been called on the rest. £506 has been paid, and £1 is in arrears.

Lynton and Lynmouth Electric Light Company, Limited (41,835).—This company's annual return was filed on November 6th. The capital is £8,000 in £1 shares, and 4,127 have been taken up; 3,900 are considered as paid, and £1 per share has been called and paid on the rest.

CITY NOTES.

City and South London Railway Company, Limited.—The accounts for the half-year ended December 31st show a balance, after providing for preferential charges, sufficient to allow the payment of a dividend on the consolidated ordinary stock at the rate of 1¾ per cent. per annum, carrying forward a balance of £1,313 to the new account. The dividend for the corresponding period last year was at the rate of 1¼ per cent. per annum, the balance carried forward being £1,220.

The Direct United States Cable Company, Limited.—The board has resolved upon the payment of an interim dividend of 2s. 6d. per share, free of income-tax, being at the rate of 2½ per cent. per annum for the quarter ending December 31st, 1896, such dividend to be payable on and after the 30th inst., setting aside £12,000 to Reserve Fund Account, and carrying forward a balance of £4,843 10s. 6d.

The Submarine Cables Trust Company, Limited.—This company gives notice that on and after January 15th, the sum of 12s. 6d., balance of the coupon due October 15th, 1896, will be paid by Messrs. Glyn, Mills & Co., of 67, Lombard Street, between the hours of 10 a.m. and 2 p.m. The coupons should be left with the bankers for examination four clear days before payment.

Salt Lake and Ogden Gas and Electric Light Company, Limited.—The warrants for the dividend on the 5 per cent. cumulative preference shares, due on Monday, were duly posted.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending January 10th, 1897, were £1,111; week ending January 12th, 1896, £1,020; increase, £91; total receipts for half-year, 1897, £2,188; corresponding period, 1896, £2,037; increase, £151.

The Great Northern Telegraph Company. The receipts in December, 1896, were £24,300; January 1st to December 31st, 1896, £285,800; corresponding months, 1895, £312,400; corresponding months, 1894, £285,800.

The Liverpool Overhead Railway Company. The receipts for the week ending January 10th, 1897, amounted to £1,265; corresponding week last year, £1,120; increase, £145.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending January 8th, 1897, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,523.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue	NAME.	Stock or Share. ‡	Dividends for the last three years. 1894.	1895.	1896.	Closing Quotation, Jan. 6th.	Closing Quotation, Jan. 13th.	Business done during week ended Jan. 13th, 1897. Highest.	Lowest.
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	...	100 —104	100 —104	101¼	101
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	8½— 9½	8½— 9½	..	...
1,012,880£	Anglo-American Teleg., Ltd.	Stock	£2 2s.	£2 9s.	...	52 — 55	53 — 56	54½	..
2,993,560£	Do. do. 6 % Pref.	Stock	£4 4s.	£4 18s.	...	96 — 97	98 — 99	98¾	96¾
2,993,560£	Do. do. Defd.	Stock	...	...	...	10 — 10½	10½ — 11	10¾	10¼
130,000	Brazilian Submarine Teleg., Ltd.	10	7 %	7 %	...	14½— 15½	14½— 15½	15 3/16	15
75,000£	Do. do. 5 %, Debs., 2nd series, 1906	100	5 %	5 %	...	113 —117xd	113 —117	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	2½%	4 %	...	3½— 3¾	3½— 3¾	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	...	160 —170	160 —170	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	1½%	1½%	...	1/16— 3/16	1/16— 3/16	...	...
15,000	Cuba Teleg., Ltd.	10	8 %	8 %	...	12 — 13	12 — 13	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	...	3½— 4½	3½— 4½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	10 — 10½	10 — 10½	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	4½%	4½%	...	105 —108%	105 —108 %	..	...
60,710	Direct United States Cable, Ltd.	20	2 %	2½%	...	9½— 9¾	9½— 10	9⅝	9⅜
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½%	6½%	...	17 — 17½	17 — 17½	17 9/16	17½
70,000	Do. 6 % Cum. Pref.	10	6 %	6	...	18 — 19	18 — 19	18 9/16	18 5/16
102,100£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	...	104 —107	104 —107	...	...
1,297,837£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	127 —130	127 —130	128	...
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	...	17 — 17½	17 — 17½	17⅝	17½
54,100£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	...	100 —104 xd	100 —104	...	...
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	...	101 —104 xd	101 —104	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	128 —131	128 —131	...	...
80,600£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	...	100 —104 xd	100 —104	...	...
107,600£	Do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	...	101 —104 xd	101 —104	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	...	108 —111	108 —111	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	...	109 —112 %	109 —112 %	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4½%	4½%	...	10¾— 11¼	10½— 11	11 1/16	10⅝
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	17½— 17¾	17 — 17½	17⅝	17
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅝%	10 %	...	24 — 25	24 — 25	25	...
180,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	...	104 —107	104 —107	..	..
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	...	53 — 56	53 — 55	55½	54½
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	...	109 —112	109 —112	...	
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	4 %	4 %	...	2 — 2⅛	2 — 2⅛	...	
484,597	National Teleph., Ltd., 1 to 484,597	5	5 %	5⅛%	...	7⅛— 7⅜	7⅛— 7⅜	7 1/16	7 9/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	17 — 19	17 — 19	17 5/16	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	17 — 19	17 — 19	...	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	...	6⅜— 7	6⅜— 7	6 15/16	...
1,100,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	...	105 —108 xd	105 —108	107	105½
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	4¼%	5 %	...	1/4 - 3/8	1/4— 3/8	...	
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	...	106 - 109 xd	106 —109	...	...
11,839	Reuter's Ltd.	8	nil	5 %	...	7 — 8	7 — 8	...	...
8,881	Submarine Cables Trust	Cert.	...	...	...	138 —143	138 —143	139½	138½
58,800	United River Plate Teleph., Ltd.	5	3 %	4 %	...	3¼— 3⅜	3¼— 3⅜	...	...
146,732£	Do. do. 5 % Debs.	Stock	5 %	5 %	...	100 —105 xd	100 —105	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	18	nil	4 %	...	5 — 6	5 — 6	..	...
238,800£	Do. do. do. 5 % Debs.	100	5 %	5 %	...	103 —106	103 —106	103½	...
30,000	West Coast of America Teleg., Ltd.	10	nil	nil	...	0 — 1	0 — 1	...	...
158,000£	Do. do. do. 8 % Debs., repay. 1902	100	8 %	8 %	...	89 95 xd	89 — 95	...	...
54,243	Western and Brazilian Teleg., Ltd.	15	3 %	3 %	...	8¼— 8⅜	8¼— 8⅜	8⅜	.
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	...	6½— 6⅝	6½— 6⅝	6⅝	6½
33,129	Do. do. do. Def. Ord.	7½	1 %	1 %	...	2¼— 2⅜	2¼— 2⅜	2½	...
155,280£	Do. do. do. 6% Debs. "A," 1880 Red.	100	6 %	6 %	...	105 —109	105 —109	...	...
206,400£	Do. do. do. do "B," do.	100	6 %	6 %	...	105 —109	105 —109	...	...
88,821	West India and Panama Teleg., Ltd.	10	1⅝%	1⅝%	...	1½— 1⅝	1½— 1⅝	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	11½— 12	11½— 12	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	9½— 10½	9½— 10½	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	...	107 —110 xd	107 —110	...	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	...	107 —112	107 —112	...	...
164,300£	Do. do. 6 % Ster. Bonds ...	100	6 %	6 %	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4½%	5 %	...	9¼— 9⅜	9¼— 9⅜	9⅜	9¼
10,277	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	5 %	5 %	...	8¼— 8⅜	8½— 9	8 13/16	8⅜
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	4½%	...	112 —115 xd	112 —115	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	5 %	5 %	...	15½— 16½	15½— 16½	16	...
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	16½— 17½	16½— 17½	17½	16 15/16
300,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	..	127 —131 xd	128 —132	131½	...
22,475	County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1—22,475	10	...	nil	...	8 — 9	8 — 9	...	..
20,000	Do. do. do. 6% Pref., 40,001—50,000 ...	10	...	6 %	...	13⅜— 14½	13½— 14	13 15/16	13⅜
10,000	Do. do. do. iss. at 2 pm., all paid	10	...	...	...	9½— 10½	9½— 10½	...	..
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ..	10	3 %	4 %	...	12½— 13½	12½— 13½	13½	12⅝
12,500	Do. Ord., 50,001—62,500, iss. at £2 prem., £1 paid	10	...	...	...	6½— 7	6½— 7	...	...
1 >0,000£	Do. 4½% first mortgage debenture stock	..	4½%	4½%	...	119 —122 xd	119 —122	119	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	1 %	2 %	..	10 — 11	10½— 11½	..	...
19,980	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	6½%	7½%	...	12 — 13	12 — 13	12½	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	...	9½— 10½	9½— 10½	9⅝	..
50,000	Do. do. 4 % Deb. stock Red. ...	Stock	...	...	...	104 —107 xd	104 —107	..	
67,900	*Westminster Electric Supply Corpn., Ord., 101 to 60,000	5	5 %	7 %	...	11 — 12	11 - 12	11⅛	11½

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.

§ Dividends marked ‡ are for a year consistin one year and the first par[t] o[f] the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1894.	1895.	1896.	Closing Quotation Jan. 6th.	Closing Quotation, Jan. 13th.	Business done during week ended Jan. 13th, 1897. Highest.	Lowest
£0,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	S	2½%	...	...	¾ — 1	⅝ — ⅞	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	...	...	1 — 1¼	1 — 1¼	...	...
125,000	Do. do. 4½ % Perp. Deb. Stock.... ...	Stock	4½%	...	...	110 —113	110 —113	...	...
76,770	Do. do. 4½% 2nd Deb. Stock Red. ...	Stock	...	...	...	94 — 98 xd	94 — 98	...	...
9,104	Central London Railway, Ord. Shares	10	...	...	...	9⅜— 10¼	9⅜— 10¼	10	9⅞
207,649	Do. do. do. £4 paid	10	...	...	...	3½— 4	3½— 4	3 15/16	3⅞
630,000	City and South London Railway	Stock	1½%	1 8/16%	1 9/16%	54 — 56	56 — 58	57½	56
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	*nil*	*nil*	...	1⅜ — 2¼	1⅜ — 2¼	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	5 %	5 %	...	1⅜— 2¼	1⅜— 2¼	...	...
17,139	Do. do. do. "A" Shares 01—017,139	5	5 %	5 %	...	3 — 4	3 — 4	...	...
100,000	Do. do. do. 4½% Deb. Stock Red. ...	Stock	4½%	4½%	...	105 —110 xd	105 —110	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	5 %	...	1⅝— 1⅝	1⅝— 1⅝	1½	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	...	2½— 3	2½— 3	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	...	...	⅝— ⅝	⅝— ⅝	...	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	...	...	½— ½	½— ½	...	...
9,600	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	*nil*	10½%	...	10½— 11½	10½— 11½	...	...
10,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	6 %	8 %	...	17½ - 18½	17½— 18½	18½	17½
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	...	18½ — 19½	18½— 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	4½%	...	109 —114	109 —114	...	...
56,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	10 %	10 %	...	20½ — 21½	20½ — 21½	21 3/16	20⅝
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	105 —108	105 —108	...	...
37,500	Liverpool Overhead Railway, Ord.	10	1½%	2⅝%	...	14 — 14½	14⅛ - 14⅜	...	...
10,000	Do. do. Pref., £10 paid	10	5 %	5 %	...	17 — 17½	16½ — 17	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	15 %	...	40 — 43	40 — 43	41	40
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	...	102 —105 xd	102 —105	...	...
54,000	Waterloo and City Railway, Nos. 1 to 54,000, £6 paid ...	10	...	...	...	7½— 8	7½— 8	7⅞	...

Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.
CROMPTON & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7½%; 1890—6%

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply Company, Ordinary of £5 (£4 paid), 7⅞, £5 (fully paid) 9⅛.
Electric Construction Corporation, 6 % Debentures, 102—105 xd.
House-to-House Company (£5 paid), 4⅜—5¼.
Do. do. 7 % Preference, of £5, 9—9½.
Do. do. 4½% Debentures of £100 107—109 xd.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 10—10½; 1st Preference Cumulative 6 %, £5 (fully paid), 8½—8⅝.
London Electric Supply Corporation, £5 Ordinary, 1—1¼.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 6⅜—7½.

* From Birmingham Share List.

Bank rate of discount, 4 per cent. (October 22nd, 1896).

ELECTRIC RAILWAYS.

THE latest course of developments in electric traction methods in the United States continues to be marked by contributions from one engineer after another upon the questions recently discussed by the American Institute of Electrical Engineers under the general heading of "Electric Traction under Steam Railway Conditions." We have already dealt in abstract with the remarks made by Mr. Baxter and Dr. Emery, and now Mr. H. M. Brinkerhoff steps forward to keep the ball rolling.

He first of all gives a hasty outline of what has already been done: and there is no need to repeat it, for we all know the present status of the art—at least those of us who read the technical papers and keep abreast, if not ahead, of the times.

Then he compares the objections respectively to the trolley wire and third rail systems; how, in the first case, there is possible danger to employés and passengers from poles between the tracks; also the considerable expense of overhead structure; and, lastly, the difficulty of maintaining contact with the trolley wire at high speeds. In the second case there is perhaps an equal element of danger though from shock rather than mechanical injury; and this applies not only to employés but to the public also, especially at level crossings. Other objections which he discusses—such as platforms (*sic!*) on a level with the track—concern American working conditions rather than such as prevail in this country, and do not, therefore, require consideration here.

Mr. Brinkerhoff comes to the conclusion from experience on the Metropolitan Elevated Railroad in Chicago that there is no real danger to employés from shock; and he would doubtless receive corroboration in this from the management of the Liverpool Overhead Railway.

As for danger to the public at level crossings, that, of course, is soon got over by putting in a dead section of contact rail, with contact shoes at each end of train or car, so as to bridge over the crossing and make contact ahead before breaking it behind.

His further remarks are extremely sensible and well found, involving as they do the consideration of traffic requirements which are sometimes lost sight of. It is practically necessary he points out, to change the method of handling trains on steam roads, by breaking up the train units. This use of a large number of smaller trains at more frequent intervals limits electric traction at present to systems such as those with a heavy local or suburban traffic.

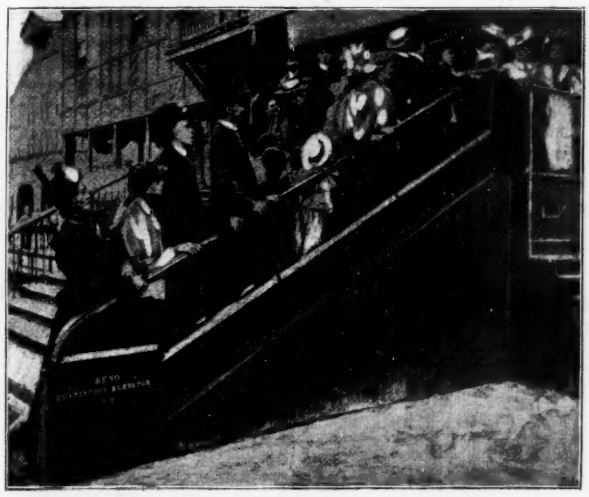
Obviously it is too big a mouthful for a large railway company to swallow all at once, for its management to propose that in future the rule shall be, short trains, and plenty of them. Yet what enormous convenience would result. Is the traffic on any given day in any given direction extra light or extra heavy? Such a condition of service is at once met with a minimum loss of time and trouble at the terminus, by taking off or adding more motor cars in accordance with the loads to be carried. Doubtless the traffic and locomotive superintendents of to-day would be shocked at the suggestion of indiscriminately despatching rolling stock outside the regular routine; but then a motor car is able to put up anywhere along the line, whilst a steam locomotive must return to its regular roundhouse to be cleaned up.

In touching upon other points, Mr. Brinkerhoff must be cited as preferring the third rail to be placed *outside* the line rails rather than between them. He comes to this conclusion mainly because in the latter case there is so little room to spare between the conductor rail and motor, &c., on the car (with consequent danger of short circuits) and also the complications at points and crossings.

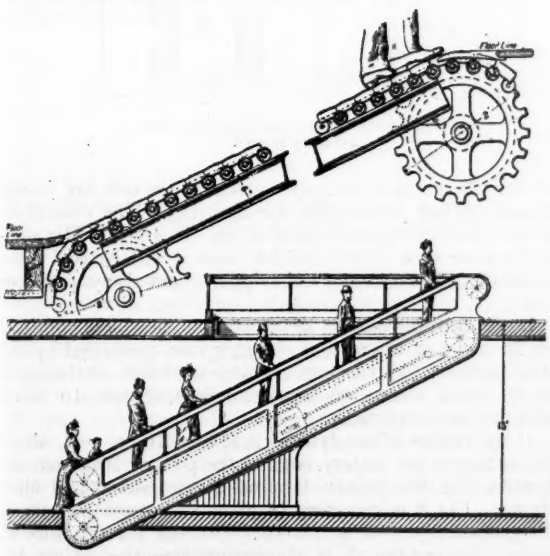
It does not appear, however, that any serious difficulty is experienced in this direction at Liverpool; and we, ourselves, hardly see the extreme force of Mr. Brinkerhoff's objections. It is not, however, a question to be decided offhand, and we hope, therefore, to see other opinions regarding this point from men of experience.

THE RENO INCLINED ELEVATOR SYSTEM.

WHAT appears to be a very valuable system for handling large crowds at elevated and underground stations and other places where many people per hour must go from one level to another, is, says the *Street Railway Review*, being introduced by the Reno Inclined Elevator Company, of New York. Its principle is simply that of the treadmill reversed. Our engravings show the working of the apparatus. The passenger steps on the moving incline at the bottom and is conveyed to the top. The hand-rail is also made to move



at the same rate as the incline. The first objection that the average person raises to the arrangement is the danger of catching feet or clothing at the top when the change from the incline to the stationary floor is made. This has, however, been amply provided for. The surface of the incline consists of a series of shallow rubber-covered ridges, which, at the top, pass between the prongs of the comb-shaped landing, as shown in one of the engravings. In this way a



PLANS OF RENO INCLINED ELEVATOR.

passenger is slid upon the landing without a chance of injury or catching of clothing, even though entirely unfamiliar with the device. The ends of the prongs are bent down slightly, as shown, so that even cotton waste, when thrown on the incline, will not catch.

A narrow incline of this kind has been given a practical test at the old iron pier, Coney Island, this fall, with the idea of demonstrating its practicability to the trustees of the Brooklyn Bridge, the officers of the elevated roads, and the Boston subway. The capacity of a single file elevator is 3,000 people per hour, and by increasing the width the capacity can be correspondingly increased. The system is manifestly superior to vertical elevators for many places, because people are handled by it continuously, and without delay, and no attendant is required.

[This may possibly commend itself to the projectors of some of our new underground electric railways!—EDS. ELEC. REV.]

TYPICAL ELECTRIC PLANT FOR COUNTRY RESIDENCES.*

BY MAURICE BARNETT.

UP to a year or two ago the electric lighting of private residences was confined almost exclusively to those located in the cities. Very few country houses were thus lighted, as it was thought that in the absence of electric companies' mains an incandescent system could not be adopted except at a prohibitory cost. Further it was imagined that if a generator plant were installed for country house lighting, the vibrations produced by the engine would be objectionable, and that it would be necessary to start the whole plant to take advantage of a single lamp.

It is the purpose of the writer to show, in the following paragraphs, that not only can electric lighting be carried on economically in the country, but that by means of a generator plant combined with a storage battery, the dynamo capacity can be doubled and light had at any hour of the day or night without the necessity of running the engine more than a few hours three or four times a week except where the full capacity of the dynamo is wanted nightly or to meet the demand for a special occasion.

With regard to the cost of operating an isolated plant in the country, it may be said that this is less than *equivalent* illumination can be had by any other known means save water-power.

There is no question of this since the improvement of gas, gasoline and naphtha engines has made possible the use of a prime mover possessed of high efficiency, and in operating which there are no stand-over losses. It is a matter of common knowledge that a given amount of gas or oil used to operate an engine driving a dynamo will furnish more light than when this same gas or oil is burned from a tip or wick. The introduction of a storage battery in such a system renders it satisfactory in the highest degree, inasmuch as it makes possible an absolutely steady light produced at a cost lower than is possible with boiler and steam engine, and nearly as low as it can be by water-power.

In order that this article may be of value to the practical electrician, the writer will take the case of a house in which 30 to 40 lamps are used on an average, but which is wired for 100 lamps, all of which may be used on special occasions, and will consider the apparatus required and method of connecting up the same to meet the conditions that arise in such instances.

It has already been stated that for isolated plants the gas, gasoline, and naphtha engines are efficient and economical; and as they can be started up at a moment's notice, require no skilled attention, demand little storage room for fuel, are very serviceable for this work. Next in importance is the dynamo, which should be, say, a 50-light shunt-wound machine supplied with a rheostat for regulating the E.M.F.

With regard to the battery, it can be stated that ordinarily 58 cells will give all the pressure required for house work. If the battery is placed too far from lamps or, in other words, if the resistance of circuit is greater than should be the case, it may be necessary to add a couple of extra cells. To ascertain the capacity the battery should have, it is necessary to know what work it has to perform. The case in point calls for a 50-lamp battery by which the output of the dynamos may be doubled on special occasions and which, being charged three or four times a week, would furnish all the light normally required day and night during the week. Figuring that 50 lamps require a current output of 30 amperes it is evident since the normal discharge rate is an

* *American Electrician.*

8-hour rate the capacity of battery should be 240 ampere-hours.

In addition to the foregoing, the following apparatus will be required: two ammeters, one voltmeter, one overload switch (for automatically cutting battery out of circuit if it should for any reason begin to discharge at too rapid a rate), one underload switch for automatically cutting battery out of charging circuit in case voltage of dynamo should fall below that of battery (in which case the battery would run the dynamo as a motor). There would also be required about 10 counter E.M.F. cells for reducing the battery pressure at beginning of discharge, and also for reducing the dynamo voltage on the lamps when the battery is being charged at the same time dynamo is used on lamps. Lastly, there would be required a 3-point voltmeter switch connected up with the voltmeter so that the voltage can be ascertained any moment at the terminals of the dynamo, the terminals of the battery and on the lamps, also a counter-cell switch and a dynamo and a battery switch.

The method of connecting in a storage battery plant where the generator is shunt-wound and capable of giving the

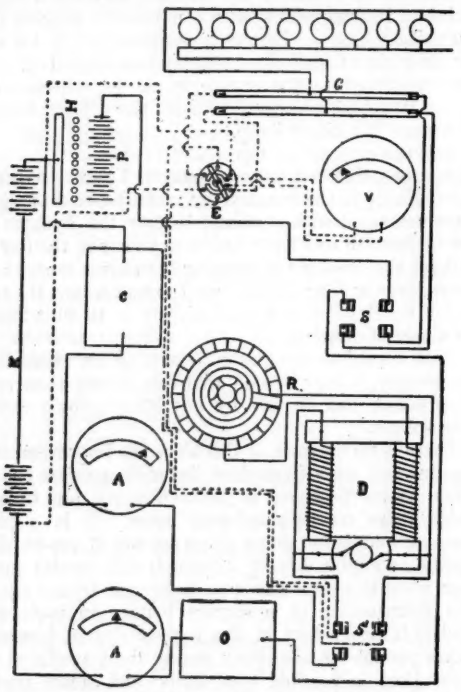


FIG. 1.—CONNECTIONS OF STORAGE BATTERY PLANT.

E.M.F. required (2½ volts per cell) for charging the battery, is shown in fig. 1, in which

A = ammeters.	S = lamp switch.
V = voltmeter.	S′ = dynamo switch.
E = voltmeter switch.	O = overload ,,
G = bus bars.	C = underload ,,
L = lamps.	K = battery.
D = dynamo.	H = counter-cell switch.
R = rheostat.	P = counter E.M.F. cells.

By reference to fig. 1, it is seen that the lamps can be run from the battery alone or from the battery and dynamo working together in parallel. The drawing also shows that the voltage on lamps can be maintained constant, in spite of the high E.M.F. required to charge the battery, by the aid of the counter E.M.F. cells, which are arranged in circuit between the dynamo and the lamps and are always under control by means of the counter-cell switch.

For a lighting plant already in existence and in which the voltage of the dynamo is not great enough to charge the battery, the requisite E.M.F. may be secured by means of a supplementary dynamo or "booster," the field of which may be separately excited from the bus bars or from the terminals of the battery—the armature being connected in series with the main dynamo. By this arrangement the battery may be charged without increasing the voltage on the bus bars. It is furthermore of no consequence under this arrangement whether the dynamo is shunt-wound or compound.

Fig. 2 shows the method of connecting in a storage battery with a plant already in existence, in which the voltage of dynamo is not great enough to charge battery, and recourse is had to a "booster." The lettering is practically the same as in fig. 1, only here B represents the booster; D, the leads to the dynamo, and F, the field circuit switch of the booster. The E.M.F. of discharge is regulated by switching out the counter E.M.F. cells as the voltage of the battery drops.

To the electrician who is not familiar with setting up batteries the following pointers may not come amiss.

See that the elements are clean. (Dirt may impair the purity of the electrolyte and lead to short-circuiting within the cell.)

Clean the lead lugs well before applying bolt connectors, which are to be screwed up tight in order to make a good connection.

Cells are always to be arranged in series. The negative pole may be distinguished from positive by reason of the fact that there is always one more negative than positive plate in every cell. The negative plates are gray, the positives

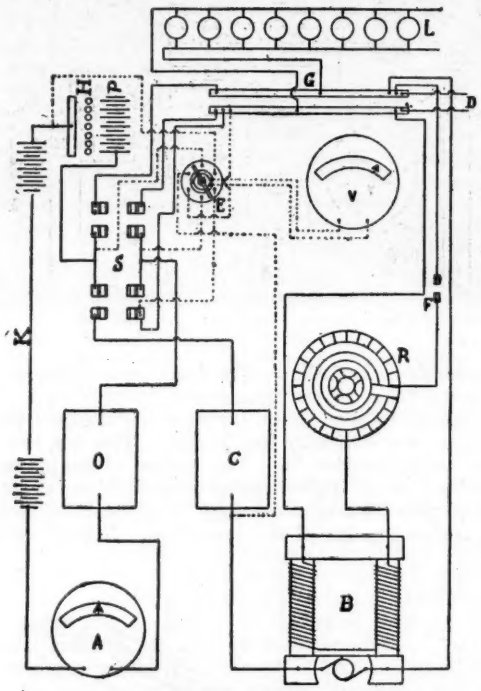


FIG. 2.—CONNECTIONS OF BOOSTER STORAGE BATTERY PLANT.

brown. Do not add electrolyte unless all the cells are joined up and current is available for charging. The electrolyte should be dilute sulphuric acid of Sp. Gr. 1·200. Mix electrolyte some time before using so that it will be cool when required. (Mixing water and sulphuric acid always produces heat.)

Begin charging as soon as the cells are filled and continue for 20 hours at the normal charging rate prescribed by the manufacturer. If it be impracticable to charge continuously for 20 hours, charge, on successive days, at least 10 hours each day uninterruptedly.

If the voltage of the dynamo is at least 10 per cent. above the voltage of the battery, connect the positive lead from the dynamo with the positive terminal of the battery and close circuit. (As it is necessary to give the correct polarity to the generator proceed as follows:—Cut out the armature by raising the brushes off of the commutator, then adjust the field rheostat so that all the resistance is in circuit and, finally, close the battery circuit; then the residual charge of the cells will send a current around the field-magnets giving to them the correct polarity.) Charge until cells show 2·5 volts per cell. Do not discharge down below 1·8 volts per cell, and *never allow cells to stand when discharged.* When run down, charge immediately.

If it be not intended to use the cells for a long time, say two months, treat as follows:—Charge up fully, draw out

25 per cent. of capacity, remove the elements from the electrolyte and rinse well with water. When the elements are again to be put in service, add electrolyte and charge 20 hours—the same as with new element.

New cells do not give their full capacity until 10 or 15 discharges have been made.

The plates must always be covered by the electrolyte.

The density falls during discharge and rises during charging.

Test the cells separately from time to time with hydrometer and cell tester. If any show low voltage, which cannot be overcome by careful watching, cut out during discharge and reinsert on charging.

By attending to the foregoing instructions no trouble will be had with a battery plant.

In the first part of this article attention was directed to the practicability of using gas, gasoline and naphtha engines for isolated plant work on the ground that with this form of motive power, electricity could be generated cheaply. Thus far nothing has been said regarding the relative first cost of a steam engine plant and a gas engine-storage battery plant. Within the limits of an article like the present one, an analysis of this expense cannot be attempted. It is evident that the steam engine plant is free from the cost of a storage battery; but on the other hand the gas engine battery plant is free from the expense of steam generating apparatus. Whatever the difference between the two it will not be very great. Even if the gas engine battery arrangement were slightly expensive, the increased cost would be justified a dozen times over by reason of the better light afforded, the facility with which some light can be had at any hour of day or night without the necessity of starting up generator, and the fact that no skilled help is needed to run a gas engine plant.

From considerations like these it must be evident that the electric lighting of country houses is practicable whether looked at from the point of view of first cost, operating expenses, ease of manipulation or adaptability of plant to the needs of the owners. This last point is quite a desideratum. Most persons like to have their house quiet at night. With a gas engine-battery plant there would rarely be any necessity for running generator at night.

These facts have but lately received general recognition, and already there has been a rapid extension of country house lighting, a fact which indicates that in the next few years, when the practicability and utility of a combination of generator plant with storage battery for country houses is better understood, there will be even greater activity in this kind of installation.

REVIEWS.

Transformers for Single and Multiphase Currents. By GISBERT KAPP, M.I.C.E., M.I.E.E. London: Whittaker and Co. 1896.

This is a treatise on the theory, construction, and use of transformers for single and polyphase currents, and is a translation by the author himself of his German publications.

All electricians are well acquainted with Mr. Kapp through his previous publications—"Dynamos, Alternators, and Transformers," "Electrical Transmission of Energy, &c.," and many have profited by the practical information which he has rendered accessible. The author has in his other works dealt with transformers, but only to the slight extent possible in treatises which comprise descriptions of the many machines of the electrical engineering family. We venture to think that a book devoted solely to transformers, and written from a practical point of view, will receive a hearty and well-earned reception.

The author is an eminently practical man, and those portions of his book which treat of the actual manufacture and building up of transformers form a most valuable addition to the literature of electro-technics, and the reader who is of a practical turn of mind, and who possesses little theoretical and no mathematical knowledge will have no fault to find.

The theorist, however, and the mathematician would be distressed on encountering the laxity of expression and the symbolic oddities which pervade this treatise on transformers. Is the English language so poverty stricken that perfectly definite words or phrases cannot be found to express definite ideas? We refer more particularly now to the author's use of the word "*effective*." Why does he call *root mean square* values of alternating E.M.Fs. and currents *effective* currents and *effective* E.M.Fs. In general the *root mean square* current is not effective, if by effective we mean that which contributes to the power developed. We prefer to call that component of the current which in phase with the impressed E.M.F. the *effective* current. If *root mean square* is meant, why not write R.M.S., and so convey a definite meaning? Some writers use the term "*virtual*," but this is not quite satisfactory, though it is infinitely more suitable than the term "*effective*."

If writers on electrical technology would uniformly adopt a suitable phraseology, they would benefit the science not a little. Nothing is so confusing as to read books by different authors when there is not agreement in the use of terms.

Another objectionable feature—and a very prominent one too—of the book is the use of the twirl $\sim$ to represent the frequency of the alternating current. This is a sign which we hope will not be generally adopted. On page 12 is the equation

$$\text{E} = 2\pi \sim \text{N} \sin \alpha,$$

by which a novice would probably understand that E = the difference between 2π and N sin α.

It is better to avoid the possibility of confusion either by laxity of expression or of nomenclature. The subject presents sufficient difficulties in itself without increasing them by the use of doubtful expressions and symbols.

Chapter I. is of an introductory nature, dealing only with the fundamental principles of the subject.

Chapter II. deals with the losses in transformers. A detailed discussion is entered into regarding the influence of the E.M.F. curve on hysteresis loss, but does not seem quite up to date, since now we know that hysteresis loss depends only upon the *area* of the E.M.F. curve—that is the area of the half wave. Had this been inserted, pages 25—30 might have been omitted, since the results there obtained follow as a necessary consequence. The remainder of Chapter II. and the whole of Chapter III. contains an admirable discussion of the relative advantages and disadvantages of core and shell transformers, with directions for the construction of the iron part, and results of tests on the heating of transformers under various conditions.

In Chapter IV. is discussed the determination of the power of an alternating current; the no-load current and the way in which it is influenced by but-joints.

Chapter V. contains the complete design of two transformers, with valuable information on the cost of working. Magnetic leakage and secondary drop of volts are considered in Chapter VI., and the methods being graphical render them particularly useful to all readers alike. After this follows an investigation of the various methods of measuring power in inductive circuits. Testing transformers and the determination of the permeability and hysteresis loss in sheet iron form an important part of Chapter VII.

In Chapter VIII. are considered such practical questions as sub-stations and house transformers, boosters, choking coils, compensating coils, &c., while the last chapter contains an illustrated description of typical single-phase and multiphase transformers.

We have noted what we consider objectionable features in a book on alternating currents; these are few and could easily be remedied in a later edition. The book, as a whole, is a valuable addition to the literature on alternating currents, and will, we are sure, be appreciated.

In conclusion, we note a few errata—chiefly typographical—page 16, equation (4), the lower limit, zero, of the integral is omitted; page 80, line 6, read $\mu = \frac{\text{B}\, l}{1{\cdot}78\, n\, i_\mu}$; page 80, line 5, read $i_\mu = \frac{\text{B}}{1{\cdot}78\, n}\left(\frac{l}{\mu} + \delta\right)$; page 149, line 21, read $\int_0^\tau \text{I}\, e\, dt = \text{W} \int_0^\tau \text{I}\, i\, dt$; page 177, last line but one, for *forces* read *fuses*.

Chemistry for Engineers and Manufacturers. By BERTRAM BLOUNT and A. G. BLOXAM. Vol I. London: Chas. Griffin & Co. 1896.

In this first volume of a very useful book will be found dealt with the chemistry of engineering, building, and metallurgy—not, perhaps, to the extent that an expert would consider necessary to make the book valuable to him in his own special line, but in a manner suitable for the general uses of the all round man. The need of particular knowledge of cement manufacture may not, for example, be necessary to the builder, architect, or engineer, but each one ought to have at least an intelligent knowledge of the process of manufacture, and know something of the chemical reactions causing hardening, and of the adulterants which are used to cover faults or enhance specified requirements. The steam user, too, is often put to trouble for lack of some reliable information of the ingredients of hard water and the treatment of scale, or, better still, its prevention. The remarks on this subject are good.

The subject matter of the chapters is roughly comprised under the titles of "Materials for Construction," including paint and preservatives; the "Chemistry of Fuels," including producer gas and petroleum; the "Chemistry of Steam Raising and of Lubrication;" the "Metallurgy of Iron and other Metals," this latter section occupying nearly half the book.

The authors particularly state that they make no pretence to affording full information on the subjects dealt with, but they hope to have explained general principles, and to have given to a manufacturer or a steam user such information as will enable him to detect causes of bad economy.

On the subject of lubricants, we note a very serious error in the statement "tallow is esteemed for heavy loads and high temperatures, and is, therefore, used for cylinder lubrication." Surely no one now uses tallow in a steam cylinder. Useful as it may be on a cool bearing, tallow is almost as liquid as water when highly heated, indeed, when only moderately hot, and is quite unsuitable on this account alone for cylinder work. Moreover, its acid decomposition—but this point is referred to, and we need say no more.

Beyond imperfections of this kind, which are not many, the book is, so far as we can see, of a good and practical sort, and will be useful to engineers.

ON THE MAGNETIC PERMEABILITY OF LIQUID OXYGEN AND LIQUID AIR.

BY J. A. FLEMING, M.A., D.Sc., F.R.S., and JAMES DEWAR, LL.D., F.R.S.*

(*Concluded from page* 59.)

EXP. XII.

The transformer in liquid oxygen.		The transformer lifted out of liquid oxygen into cold gaseous oxygen at same temperature.	
Current reversed in primary coils, in amperes.	Ballistic throw in millimetres. Deflection to the right.	Current reversed in primary coils, in amperes.	Ballistic throw in millimetres. Deflection to the right.
58·8	10·5	...	...
...	...	50·2	47·0
50·2	15·0	...	...
...	...	50·8	48·5
50·2	17·0	...	...
...	...	50·0	49·0

The above table shows the results of the observations made with the small transformer alternately placed underneath the surface of liquid oxygen, and then lifted up into the cold gaseous oxygen lying above the surface of the liquid oxygen. It will be noticed that the ballistic throws in each set of observations are not constant, but that there is a tendency, usually, for the throw to increase if repeated, whilst the transformer is still maintained in the same condition. This is in all probability due to the fact that the continued passage of the primary current heats the primary circuit of the balancing induction coil and hence heats also, by radiation, the secondary coil of the balancing induction coil, and therefore, by enlarging the area of the adjusting coil, continually breaks down the inductive balance. It was found necessary, therefore, to take the observations in groups at equal intervals of time. First, a group of three observations was taken, the transformer being in liquid oxygen, the balance being, as nearly as possible, obtained. Then the transformer was lifted out of the liquid oxygen, and the ballistic throws again taken, reversing the same primary current; then again immersed in liquid oxygen, and finally once more taken out of the liquid oxygen. Taking the sets of observations marked I., II., III., IV., the mean of the means of the three observations in Sets I. and III., corrected for the variation in the primary current, were taken as the result of the measurement in liquid oxygen, and this result was then compared with the ballistic throws in Set II.

Again, the mean of the means of sets of observations II. and IV., properly corrected for variation of primary current, were compared with the mean of the observations in Set III., and the result is to give the data for calculating the permeability of the liquid oxygen for a primary current through the primary coil of the transformer of about 37 amperes, corresponding very nearly to a mean magnetising force of 166 C.G.S. units. The sum or difference of these means of the throws, taken in the liquid oxygen and out of the liquid oxygen, depending on whether they are on the opposite or the same side of the zero of the scale, gives us the value of the quantity denoted by D in the Table I. below, and in the formula for the value of μ.

The above sets of observations, I., II., III., and IV., refer to a primary current of about 37 amperes; but similar sets of observations were taken with a primary current of about 8 amperes, 28 amperes, and 50 amperes respectively, and the results of all these observations, which are included in the sets of observations, I. to XII., above given, have been reduced in Table I. below to show the magnetic permeability of the liquid oxygen corresponding to different magnetising currents. The set of observations marked Experiment V. and Experiment VI. in the above table of results, gives the observations for standardising the ballistic galvanometer. In the first case the primary coil of the balancing induction coil was cut out, and a primary current, having a value of 0·1145 ampere, was reversed through the primary coil of the transformer alone, and gave ballistic deflections as stated in the observations in Set V. These observations serve to standardise the galvanometer and interpret the meaning of the throw obtained when the large current is reversed through the primaries of the two induction coils, the secondaries of which are opposed. It will be noticed that one important advantage of the above-described method is, that the quantity which we desired to know, viz., the amount by which the presence of the liquid oxygen increases the magnetic permeability of the core of the transformer, is the quantity which is measured directly, and that any error in the measurement of this quantity does not affect the permeability to anything like the same proportional extent. An error of about 10 per cent. in the measurement of the ballistic throw would only affect the fourth place of decimals in the number representing the permeability of the liquid oxygen.

The results of all the above observations, when reduced, are comprised in the following table:—

TABLE I.—TABLE OF RESULTS OF OBSERVATIONS ON THE MAGNETIC PERMEABILITY OF LIQUID OXYGEN.

A = primary current in amperes, passing through primaries of the transformer and balancing coil.	Corresponding mean magnetising force in C.G.S. units in primary circuit of transformer.	Total ballistic throw which would be produced if primary current of A amperes were reversed through primary of transformer alone $= \frac{A}{a} d$.	Ballistic throw of galvanometer resulting from immersion of the transformer in liquid oxygen. Transformer and balancing induction coil being opposed $= D$.	μ = permeability calculated from $\mu - 1 = \frac{D}{\frac{A}{a} d}$.
8·037	32·3	1,734	4·33	1·00250
28·13	123·0	6,068	14·9	1·00246
37·8	165·4	8,153	21·18	1·00260
36·8	161·0	7,938	23·57	1·00297
50·5	220·9	10,894	32·98	1·00304

The values of the permeability given in the foregoing table are not all of equal weight.

The calculated value of $\mu - 1$ depends upon the observed ballistic throw, and this cannot be read to a high degree of accuracy when the throw is as small as 4 millimetres. We consider that the best result is obtained by taking the mean of the values for the primary currents, 37·8, 36·8, and 50·5 amperes, and these values give $\mu = 1{\cdot}00287$, with a probable accuracy of $\pm$ 0·0002. This value of the permeability of the liquid oxygen corresponds to a magnetising force lying between 166 and 220 C.G.S. units. It will be seen that this method is best applicable to the determination of the permeability under large magnetising forces; and that these observations do not, in themselves, allow us to state whether the permeability is a constant for all forces, or is a function of the value of the force.

In the next place the value is a relative one. The number 1·00287 is the ratio of the magnetic permeability of liquid oxygen to that of the gaseous oxygen nearly at the same temperature resting upon the surface of the liquid. We were not able by this method to detect the difference between the permeability of the cold gaseous oxygen lying on the surface of the liquid oxygen when in quiet ebullition, and which has a temperature of about $-$ 182° C., but a density of at least three times that of oxygen at 0° when compared with that of gaseous oxygen at ordinary temperature, and under the normal pressure. In a very valuable memoir on the determination of magnetic suscepti-

* Received November 20th. Read before the Royal Society, November 26th, 1896.

bilities, M. P. Curie* has examined the susceptibility of gaseous oxygen at different temperatures, and shown that between the limits of 0° C. and 452° C. the magnetic susceptibility of oxygen (κ) per unit of mass is a function of the absolute temperature T, such that

$$10^6 \kappa = 33700/T.$$

and that the value of κ (per gram) at 0° C. is therefore $123/10^6$. The mass of 1 c.c. of oxygen gas at 0° C. and 760 mm., is 0·0014107 gram, and, reciprocally, the volume of one gram is 708·9 c.c. at 0° C. and 760 mm.

Hence the magnetic susceptibility of gaseous oxygen at 0° C. and 760 mm. per unit of volume (one c.c.) would be $123 \times 0{\cdot}00141 \times 10^{-6} = 0{\cdot}173 \times 10^{-6}$, which agrees very fairly with that of other observers.†

If then it could be supposed that gaseous oxygen followed the same law down to − 182° C., and taking the gas in a condition when the density is nearly 0·00423, the volume susceptibility (k) at − 182° C. would be $1{\cdot}6 \times 10^{-6}$, and hence the permeability (μ), where

$$\mu = 1 + 4\pi k,$$

should be 1·00002.

It is, however, certain that the susceptibility per unit of mass will not continue to increase in accordance with the hyperbolic law, because this would imply that at the absolute zero of temperature the susceptibility would be infinitely great, and hence the above number 1·00002 in all probability gives a superior limit for the permeability of the gaseous oxygen at − 182° C. lying on the surface of the liquid oxygen.‡

The conclusion is that the correction to be applied to the above observed value of μ for the liquid oxygen, viz., 1·00287, to refer it to a vacuum taken as unity, is altogether masked by the unavoidable errors of experiment, and hence, pending further more exact measurements, this may be taken as the value of the constant. We have, however, at the present time, arranged a method which will enable us we hope to determine directly the magnetic susceptibility of liquid oxygen with far greater accuracy. This method consists in observing the mechanical force which acts upon a vacuum bulb or mass of matter of known and very low susceptibility when it is suspended free from gravity in a vessel of liquid oxygen, and in a variable magnetic field. Under these conditions, a vacuum bulb of very thin glass would behave like a strongly diamagnetic body, and if the magnetic susceptibility of the vacuum bulb or test mass is k_1, and that of liquid oxygen is k_2 for equal volumes, then the apparent diamagnetic susceptibility of the mass will be $-(k_2 - k_1)$, and the actual paramagnetic susceptibility of liquid oxygen may be deduced from a knowledge of k_1 and $-(k_2 - k_1)$. By this method we hope to be able to determine whether the permeability of liquid oxygen is a function of the magnetising force. The latest experimental results and measurements made with solutions of iron salts, such as those made recently by Mr. J. S. Townsend,‖ appear to show that the magnetic permeability of solutions of these iron salts is a constant quantity at least for a range of magnetic forces varying from 1 to 9 C.G.S. units.

The value, viz., 1·00287, as determined by us for the magnetic permeability of liquid oxygen, shows that the magnetic susceptibility (k) per unit of volume is $228/10^6$. It is interesting to compare this value with the value obtained by Mr. Townsend for an aqueous solution of ferric chloride, and which he states can be calculated by the equation

$$10^6 k = 91{\cdot}6\, w - 0{\cdot}77,$$

where w is the weight of salt in grams per cubic centimetre, and k the magnetic susceptibility. Even in a saturated solution, w cannot exceed 0·6, hence, from the above equation, we find the value of the magnetic susceptibility of a saturated solution of one of the most para-magnetic iron salts, viz., ferric chloride is $54/10^6$ for magnetic forces between 1 and 9. This agrees fairly well with other determinations of the same constant. On the other hand, the magnetic susceptibility of liquid oxygen for the same volume is $228/10^6$, or more than *four times as great*. The unique position of liquid oxygen in respect of its magnetic susceptibility is thus strikingly shown. It is, however, interesting to note that its permeability lies far below that of certain solid iron alloys generally called non-magnetic.

The 12 per cent. manganese steel of Mr. R. A. Hadfield is usually spoken of as non-magnetic, yet the magnetic permeability of this last substance has been shown to be 1·3 or 1·4.

We have applied the foregoing method also to the determination of the magnetic permeability of liquid air. Since liquid air which has been standing in a vacuum vessel for any length of time has a composition which varies with the time and which may contain as much as 75 or 80 per cent. of oxygen, it was not to be expected that very closely consistent results could be obtained in the case of air. The following figures show, however, the observational results:—

PERMEABILITY OF LIQUID AIR.

Throws of Ballistic Galvanometer. Induction Coils Balanced.

Exp. I.	1·5 mm. to right 1·2 „ „ 1·1 „ „	The transformer in liquid air. Current = 38·0 amperes reversed through primary coils.
Exp. II.	17·0 mm. to left 17·5 „ „	The transformer lifted out of liquid air into cold gaseous air at the same temperature as before. 37·5 amperes reversed.
Exp. III.	0·3 mm. to right 0·3 „ „	The transformer in liquid air. Current = 37 amperes reversed through primary coils.
Exp. IV.	17·0 mm. to left 17·0 „ „ 17·3 „ „	The transformer lifted out of liquid air into cold gaseous air, and at the same temperature as before. Current = 37 amperes reversed through primary coils.
Later.		
Exp. V.	2·8 mm. to left 2·8 „ „	The transformer in liquid air. Current = 36·7 amperes reversed through primary coils.
Exp. VI.	18·8 mm. to left 19·2 „ „ 19·4 „ „ 19·8 „ „	The transformer lifted out of liquid air into cold gaseous air, at the same temperature as before. Current = 37 amperes reversed through primary coils.
Exp. VII.	3·5 mm. to left 3·4 „ „	The transformer in liquid air. Current = 36·7 amperes reversed through primary coils.
Exp. VIII.	22·0 mm. to left 22·0 „ „ 22·0 „ „	The tranformer in liquid air. Primary circuit of balancing coil cut of circuit and 0·1118 ampere reversed through primary of transformer to standardise the ballistic galvanometer.

The results of these observations, when reduced, show that corresponding to a primary current of 37·5 amperes, or a mean magnetising force of 164 C.G.S. units, the apparent magnetic permeability of liquid air, in terms of gaseous air of the same temperature, is 1·00240.

At the time of these observations the liquid air used had probably become almost entirely liquid oxygen by the evaporation of the nitrogen. The figure, however, serves to check approximately that of the liquid oxygen.

In conclusion, we desire to express our thanks to Mr. J. E. Petavel for the assistance he has given to us in the above work. We hope shortly to be able to make a further contribution to this portion of the investigations on which we are engaged on the electrical and magnetic constants of liquid oxygen, and which will include a determination of the dielectric constant of liquid oxygen, made with the object of determining the extent to which this substance obeys Maxwell's law connecting magnetic permeability, dielectric constant, and optical refractivity.

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* "Thèses présentés à la Faculté des Sciences de Paris pour obtenir le grade de Docteur ès Sciences Physiques." Par M. P. Curie, Paris, 1895." This memoir is of remarkable interest in many ways.

† Faraday, "Experimental Researches," Vol. iii., p. 502, gives a value for the susceptibility of gaseous oxygen at 60° F., referred to an equal volume of water as unity, which, when reduced to absolute values by taking the magnetic susceptibility of water as $0{\cdot}77 \times 10^{-6}$, gives the value of the susceptibility as $0{\cdot}18 \times 10^{-6}$. Becquerel found a value not very different.

‡ The critical pressure of oxygen is − 118° C. The corresponding absolute temperature is 155°. If we then put T = 155, in Curie's formula, $10^6\kappa = 33700/T$, we get $10^6\kappa = 217{\cdot}4$, as his deduced extrapolated value for the susceptibility per unit of mass. Since the density of liquid oxygen, as determined by one of us (J. Dewar) is 1·1375, our value for the susceptibility per unit of mass of the liquid oxygen is 228/1·1375 = 200·7. These figures show that the hyperbola does not represent the value of the susceptibility per unit of mass below the critical temperature.

‖ See *Phil. Trans.*, A., Vol. 187, 1896, "Magnetisation of Liquids," J. S. Townsend, M.A.

WATER TUBE BOILERS IN MARINE SERVICE.

THE New York *Herald* has been interviewing Yarrows on water tube boilers. Naturally, Yarrows plump for the water tube boiler, and the interviewed gentleman did not lose the opportunity of standing up for straight tubes and condemning the bent tubes used by other firms, whereby no doubt Thorneycrofts were intended. The folly of the daily paper in rushing into technics is illustrated by the use of such an expression as 2,000 lbs. indicated horse-power out of two boilers. Mr. Allan, who has had the courage to stand out against the risk of imperilling England's security by rash use of Belleville boilers in our navy, is stigmatised as ignorant. It appears Mr. Allan spoke of the consumption of fuel as double that of ordinary boilers. He may have spoken off hand in a conventional mode of stating a comparison, but he would, perhaps, have been not far wrong if he had said 30 to 50 per cent. greater. Ask the Brighton Railway Company. Ask the owners of the Ohio. Do they state that the consumption of fuel is about the same? We think not. We fancy Messrs. Yarrows's engineer was speaking quite as wide of facts when he claimed water tube boilers to weigh less than a third of others.

He claims their boilers to weigh 22 to 28 lbs. per horse-power; but a torpedo boat is not a big ship, and boilers that will usually not need to last longer than it takes to plant a torpedo under an enemy's stern may be good enough for a torpedo boat, and not fit for a *Majestic* or a *Terrible*. One need not worry much about men in a torpedo boat. The fact that they are there is evidence of their bravery, and all one's commiseration may be extended to them, but we need not add a special feeling on boiler account, any more than

we need feel more sorry for a man drowned in 10 feet of water than had it been 60 feet deep. The comparison of torpedo boat boilers is not a fair one. Messrs. Yarrow profess their boiler to be suitable for even Atlantic liners. Well, they may be, but all this is nothing in favour of the Belleville boiler; nor do we see how it backs up the condemnation of Mr. Allan. We fully believe, from all we can learn, that the Yarrow boiler has been a good and safe one, and we do not believe this has been proved for the Belleville. Mr. Yarrow says that on the *Hornet* the eight boilers in full working order weigh only 43 tons, and each of them has 1,027 feet of heating surface, 20·6 feet of grate area, and a power of 781 H.P., and will evaporate 12,500 lbs. of water per hour, so that 3,000 H.P. of boiler will go into the space of 2,250 H.P. of ordinary boilers. Mr. Scott, the President of the Union Iron Works of San Francisco, is of opinion that, however suitable for certain purposes, the water tube boiler is not so satisfactory or effective as the shell boiler. Again, the U.S. engineers at Mare Island are strongly in favour of the water tube boiler. In the American Navy the *Monterey* is fitted with them. These engineers claim for them higher pressures, economy of maintenance, ease of renewal without even opening the decks, small space and quick steaming, owing to the small amount of water in them. The small water content is looked on as a great advantage in case of a rupture, for there will be so much less water to escape and scald the staff below. We do not see that the *Herald* has advanced the question nearer to an issue. A heavy projectile would play equal havoc with all types of boiler, while a light one might be deflected by a stout shell boiler. We incline to the belief that outside damage may be neglected, and that the boiler should therefore be the best which is in itself least liable to accident, and most to be relied on to give safe continuous steaming. So far as damage from an enemy is to be reckoned upon, the old adage, "As well hang for a sheep as for a lamb," seems to find a fitting application.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1897.

[*Compiled expressly for this journal by* W. P. Thompson & Co., *Electrical Patent Agents*, 322, *High Holborn*, *London*, *W.C.*, *to whom all inquiries should be addressed.*]

12. "Improvements in and connected with electric motors for the propulsion of vehicles and navigable vessels." R. Neilson and W. Neilson. Dated January 1st.

15. "An improved electric light fitting." G. W. De Tunzelmann. Dated January 1st.

43. "Improvements in electric motors and apparatus for propelling cars, carriages, cycles and boats." H. F. Joel. Dated January 1st.

73. "Improvements in apparatus for the manufacture of metallic pipes and rods and for covering electric telegraph and telephone cables and wires." A. Wylie. Dated January 1st.

80. "Improvements in or connected with means for generating and applying electric currents." C. Edwards and E. W. Brown. Dated January 1st.

86. "Improvements in or connected with means for electric lighting." C. Edwards and E. W. Brown. Dated January 1st.

88. "Improvements in or relating to cathodes employed in galvanoplastic or electrotyping processes. A. Julien. Dated January 1st.

119. "Producing letters, figures, or designs for advertising purposes upon the globes of 'silvered' electric lamps and the like." E. A. Ingold. Dated January 2nd.

127. "Improved means for electrically brazing the joints or connections of cycle frames." W. S. Simpson. Dated January 2nd.

129. "Improvements in dynamo-electric machines." Siemens Bros. & Co., Ltd., and E. F. H. H. Lauckert. Dated January 2nd. (*Complete.*)

130. "Improvements in multiplex telegraphy." J. M. Barr. Dated January 2nd. (*Complete.*)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Copies of any of these Specifications may be obtained of* Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., *price, post free*, 8½*d.* (*in stamps*).]

1895.

11,892. "A hand-feed lamp or regulator for the electric arc light for projection purposes." C. M. Hepworth. Dated June 19th, 1895. Relates to arc lamps of the hand-regulated type adapted for projection purposes. The upper and lower carbon holders are carried by racked rods which gear with a pinion attached to the worm wheel. By pushing forward a rod, carrying a worm, by means of a head a rapid motion is imparted to the pinion, a gradual movement of the carbon holders being effected by rotating the head. The bearing of the rod is pivoted to allow of the worm being moved away from the worm wheel and permit of the latter being turned by hand. To permit of the adjustment of the upper carbon, the holder is carried by a frame which passes through a guide block and can be moved backwards and forwards by means of a screw. The regulating mechanism as a whole can be adjusted by means of a pinion carried by turning a slotted plate on a base plate. 6 claims.

12,157. "Improvements in electric lighting specially applicable for lighting vehicles." F. L. Berners and F. Griffen. Dated June 22nd, 1895. Relates to electric lighting appliances specially applicable for use in omnibuses and other vehicles. A secondary battery is constructed of lead plates having perforations with under cut edges, the plates being burnt together and the empty material pressed into holes. Modifications of the battery are described. The tube opening at both ends into the paper cell and communicating with the exterior of another tube permits the escape of gases from either the primary or secondary cells. The lamps are provided with holders consisting of a disc pressed upwards by a spring and two contact pieces with which L-shaped contact pieces on the lamp engage. A switch and connecting plug are constructed in a similar manner, the lamp being replaced by a handle or plug connected with the leads. 7 claims.

12,374. "Improved means for indicating and controlling the supply of electricity to portable and other electric lamps and apparatus." R. Hacking. Dated June 26th, 1895. Relates to quantity meters of the time recording type specially applicable for miner's and cyclist's lamps. The switch lever, by means of which the circuit is completed, is geared with a pivoted lever, the latter being provided with a stop which is withdrawn from the balance wheel of a clock, and the switch is turned so as to complete the circuit. Switches for automatically breaking a circuit at a predetermined time, and controlled by a clock are also described. 4 claims.

12,613. "Improvements in or connected with electric railways or electric transport." J. G. Lorrain. (F. C. Esmond, United States of America.) Dated June 29th, 1895. Relates to a system with road contacts and electro-magnetically operated switches. The exposed contacts in each switch box are two in number and are formed as bolts screwed into cross-pieces, which take under ledges and tighten up the cover of the box. The bolts and cross pieces are insulated and are connected to the electro-magnetic switch which is placed between two plates of insulating material. Two collecting bars carried by the car are used, and a battery on the car is employed to excite the switch. 3 claims.

12,614. "Improvements in or connected with electric railways or electric transport." J. G. Lorrain. (F. C. Esmond, United States of America.) Dated June 29th, 1895. Relates to a system with road contacts and electro-magnetically operated switches. Each of a pair of contacts is connected through the coil of the switch which can thus be closed in advance of the vehicle by current from the two collector bars touching the pair of road contacts. In case of failure of the line current a battery of the vehicle is thrown into the circuit by means of a switch which is used in conjunction with the driver's controlling switch. 6 claims.

12,615. "Improvements in or connected with electric railways or electric transport." J. G. Lorrain. (F. C. Esmond, United States of America.) Dated June 27th, 1895. Relates to a system with sectional conductors or with road contacts and electro-magnetically operated switches. The sectional conductors are connected in pairs to the main supply conductors through electro-magnets and switches, the collectors consisting of rollers connected in over-lapping of pairs, so that a current can flow to the forward magnet coil and close the switch. The rails may be replaced by short contacts and the rollers and long collector bars. 9 claims.

12,616. "Improvements in or connected with electric railways or electric transport." J. G. Lorrain. (F. C. Esmond, United States of America.) Dated June 29th, 1895. Relates to a system with road contacts or with sectional conductors and electro-magnetically operated switches. In one form road contacts are shown arranged side by side in pairs connected through electro-magnetic switches on a complete magnetic circuit. Two long collecting bars are used and the switches are so arranged that when they are off the magnet coil is connected through a second pair of contacts to two road contacts. Current from the collector bars will thus throw the switch, and put the road contacts and the magnet coil into the main circuit. Various modifications are described. 10 claims.

14,476. "Improvements in transmitting and receiving attachments for telephones." H. W. Libbey. Dated July 30th, 1895. Telephones are provided with attachments, so that the receiver is supported inside the bell mouthpiece of the transmitter. The mouthpiece of the receiver is conical, but has re-entrant faces formed in one or two parts so as to provide a restricted opening. In a modified form, the transmitter and receiver are set side by side at the base of a longitudinally divided bell.

14,984. "Improvements in the manufacture of insulated cables." G. H. Nisbett. Dated August 8th, 1895. Conductors are insulated by means of spirals of waterproof paper coated with insulating material. The spirals are capable of moving one over the other in bending. The core may be of strands coated as a whole, or the strands may be separately coated and then bunched. The insulated conductor or conductors is then enclosed in lead, &c., armouring squirted on not too tight to prevent the necessary movement of the insulation.